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OFFICE OF STRATEGIC SERVICES

Research & Analysis Branch

R&A 1268

SPECIAL OPERATIONS

SOUTHERN FRANCE

Railways
Telecommunications
Oil Facilities
Munitions Dumps
Water Supplies
Electric Power
Inland Waterways

Russell H. Dorr
23 June 1943

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OFFICE OF STRATEGIC SERVICES
Research & Analysis Branch

SPECIAL OPERATIONS - SOUTHERN FRANCE

Table of Contents

Introduction

A Nature of Study
B Types of Installations Considered
C Conclusions as to Significant Types of Installations
D Coordination of Plans

Railways — Tab A
Basic Strategic Assumptions — Page 1
Basis of Target System Selection — 2
Military Traffic Potential As Affecting the Value of Specific Lines — 4

General Discussion of Target Systems

System I - Isolation of Southern France — 5
System II Isolation of Mediterranean Coast — 9
System III Isolation of Biscay Coast — 12

System IV Isolation of Southern France from Italy — 15

Detailed Analysis of Each System (With maps) — 17-64

Telecommunications — Tab B
General Strategic Considerations — 1
Strategic Value of Different Types of Fixed Communications Facilities — 2
General Vulnerability Considerations — 3
Selection of Systems — 4

SECRET

Description of Systems
System I - Isolating Southern France Page 4
System II - Isolating the Mediterranean Coast 6
System III Isolating the Biscay Coast 8

Map of Systems

Oil Facilities Tab C
Strategic Significance Page 1
General 1
Types of Installations 1
Types of Products 4
Location Factors 5
Vulnerability and Approachability Factors
General 6
Terminals 7
Wholesale Bulk Stations 8
Barrel and Package Dumps 8
Selection of Target Systems 9

System I - Invasion of Both Coasts 11
System II - Invasion of Mediterranean Coast 15
System III - Invasion of Biscay Coast 19

Munitions Dumps TabD
Strategic Significance Page 1
Selection of Target Systems 1
Description of Systems 3-7
Zone of the Interior 8

Water Supplies Tab E
General Strategic Considerations 1
Basis of Selection of Recommended Targets 2
Description of Target Systems 3-7

Electric Power Tab F
Strategic Significance Page 1

Inland Waterways Tab G

SPECIAL OPERATIONS - SOUTHERN FRANCE

FIXED TARGETS

INTRODUCTION

A. Nature of Study - This target study has been prepared in aid of the formulation of an Implementation Plan for Office of Strategic Services D-Day operations in Southern France.

As the work has progressed, it has become apparent that target planning for these operations must be done in two phases. The first phase involves:

1. Narrowing down the possible types of targets to those as to operations which are likely to produce the greatest military effect.
2. Choosing from among the many objectives of each type selected, those which will produce the maximum effect with the minimum effort.

In making these choices, the factors of usefulness to the enemy military effort, availability of alternative facilities and to a lesser extent, general physical vulnerability, replacement time and approachability must be considered.

The second phase involves the procuring of detailed operational intelligence, particularly on the factors of vulnerability and approachability as to those particular

targets which the first phase study has shown to be important enough to warrant the necessary detailed examination.

This study is confined to fixed targets as opposed to targets of opportunity. It is a first phase study whose purpose is an appraisal of the most promising points of attack for sabotage operations. Action to protect installations needed by our own troops is not included.

B. Types of Installations Considered - It was decided at the start to confine the search for targets to the following types of installations:

Transport	Airfields
Communications	Electric Power
Oil	Water Supply
Munitions Dumps	Military Installations in Forward Zones

Industrial plants were excluded at once because any result achieved would take effect on enemy capabilities only after a very considerable lapse of time.

C. Conclusions As To Significant Types of Installations

1. Transport

Roads - The road network of Southern France is much more flexible in case of damage than that of the railways and there are fewer engineering works, destruction of which would stop traffic. In conjunction with operations against railways it may be possible, however, to make attacks on particular sections of road with an eye to reinforcing the effect of the main operation. This possibility merits study.

Waterways - Inland waterways were examined for targets and rejected. The only waterway of real military importance in the area is the Rhone below Lyon. There are no special operations targets on it except possibly in the delta region, where cutting off of traffic would not be of first importance.

Pipe Lines - There are no oil pipe lines in the region and the gas pipe line to Toulouse is without military significance.

Railroads - Railroads of course are of the first importance for all heavy military traffic. If attack on them can be accompanied by destruction of the enemy's forward area oil and munitions storage, the two plans will supplement each other. Failing that the main weight of the available effort should be directed against rail installations with less important targets such as telecommunications and zone of the interior oil and munitions dumps in a secondary position.

2. Communications - In the communications field it was decided that the highest yield targets would be found in the long distance telephone system. Radio installations are single point targets so that opportunities for attack are reduced and many alternatives will generally be open to the enemy. Telegraph capacity is low.

3. Electric Power - For the reasons stated in the section devoted to it, electric power installations have been dismissed as not closely connected to enemy military capabilities.

4. Water Supplies - A plan for attack on the water

supplies

of certain of the larger towns has been included partly as an attack on transport, partly as a "confusion" or morale operation. Pending full investigation of recuperation factors and the extent to which ordinary consumption can be reduced in an emergency, no clear judgment can be formed as to probable effectiveness.

5. Airfields - Low accessibility and the probability that important objectives in this class will be under continuous air bombardment limits the interest of this class of target for special operations. The best opportunities would seem to lie in the direction of opening up obstructed fields to use by our own forces. Hastily set up secondary fields with poor security organization may, in addition, offer openings to aircraft demolition squads though the results achieved in the Western Desert can hardly be duplicated under the more difficult conditions in Southern France.

6. Oil and Munitions Storage - Facilities of this kind offer targets which fit into a coordinated plan with attack on transport. Operations against one system will increase the effect of operations against the other. A serious limitation of operations against this obviously important type of target is that if they cannot be conducted in areas relatively far forward, they lose a large part of their effect. Special operations cannot destroy even a large part of the enemy's oil or munitions supplies. What they can do is to cause temporary deprivations and delays in supply at crucial moments.

But this will occur only if the destruction is close to the fighting zone. If it is seventy-five or one hundred miles back, there will almost certainly be enough stocks in the forward area to cushion the blow. Moreover these same stocks will in that case also cushion the blow of railroad blockages and reduce the effectiveness of the whole plan.

7. Military Installations in Forward Zones - Fortifications, radar and various other forward area military installations meet the necessary criteria for strategic significance but have not been considered because accessibility would almost certainly be very low.

D. Coordination of Plans - It has been assumed that a number of coordinated attacks can be staged within a short time of each other by substantial groups at rather widely separated points. Such attacks are called for against railways and long distance telephone lines. The attacks on oil and munitions storage should as noted, be synchronized with these to produce maximum effect. It is realized that in practice it may be difficult to achieve the coordination called for. Priority listings are believed to be such that if they can be given effect, considerable results may be achieved even if all the projected operations cannot be carried out simultaneously.

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Research and Analysis Branch

SPECIAL OPERATIONS TARGETS - SOUTHERN FRANCE

RAILWAYS

1. Basic Strategic Assumptions - Attack on railway traffic will be significant insofar as it inhibits the movement at or after D Day of troops and supplies to points threatened by our invasion forces. In the forward defense zone it seems reasonable to suppose that most traffic will be or can be handled by motor transport. In such an area even though rail transport may be used where it is available, the enemy is likely to be best organized to manage without it. It is in the rapid bringing forward of reinforcements and materiel from the zone of the interior that the railroads are likely to be of most use to the enemy and it has been assumed, therefore, that this is the traffic which Special Operations should be designed to interrupt. Such operations would presumably be launched approximately simultaneously with the beginning of the invasion.

In southern France the purpose will be to cut off the Biscay Coast and French Mediterranean coast from standard gauge rail communications with the rest of France and with Italy close enough to the coast to exclude intermediate reserves and supply depots, but sufficiently far back from the railheads so that the enemy will not readily be able to substitute a slightly longer motor

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transport haul for the rail traffic which is blocked.

Sabotage of rolling stock is not considered because such targets are too numerous and dispersed to be attacked with decisive effect. The sabotage of railroad engineering structures and right-of-way only is contemplated.

2. The Basis of Target System Selection - The approach has been to select areas to be cut off and lay out a system of targets for each, to achieve such isolation. Each system is so designed that attack on it will secure a maximum concentration of effect for a minimum of effort. To that end the railway network has been examined with a view of selecting the smallest number of sections of line, interruptions of traffic over which will isolate the coastal areas. While the suggested plan provides for a minimum number of attacks on each section, the period of isolation can be lengthened by additional attacks on the individual sections.

Once the most significant sections of line were decided upon, available descriptions of these sections were analyzed to determine which engineering works in each section seem to offer the most desirable specific targets. Infrequently, practicable targets were not found on the designated stretch. In such cases, a re-examination was made in order to determine whether alternative stretch with more desirable targets would serve the same purpose.

The factors of vulnerability, replaceability, and accessibility determined the relative desirability of specific points of attack.

The vulnerability factor has been considered only superficially. It has been assumed that a steel bridge or viaduct is easier to damage by explosives than is a masonry bridge and that this type in turn is more easily destroyed than one of reinforced concrete. Bridges and viaducts have been regarded as more easily damaged than tunnels. The possibility of attack by causing rock slides has not been overlooked, but the necessary data as to points susceptible to this form of attack are not yet available.

Length of time necessary to re-establish traffic will condition the effectiveness of any given damage. The following generalizations have been accepted in formulating the plan.

It will take longer to restore traffic if an engineering structure (bridge, viaduct, tunnel) is damaged than if a stretch of open line is blown up. It will take longer to repair a high bridge or viaduct than a low one; a long bridge than a short one. Damage in a long tunnel will probably block traffic for a longer period than similar damage in a short tunnel. Damage to a tunnel in loose unconsolidated rock will be far more effective than damage to a tunnel through firm rock.

No judgement has yet been formed as to the relative effectiveness of causing rock and earth slides.

Quantitative data on repair periods will be required to form a final judgment as to what structures in each section should be attacked and how long it may be possible to tie up traffic. Steps are being taken to secure such information.

The accessibility factor has been considered only in the most general way. It has been assumed that viaducts, bridges, and tunnels situated in open country or in small towns would be more accessible than similar structures in large cities. While some further data may be secured in certain instances, the SO personnel in the area can best make this operational decision.

In regard to the selection of points for attack in each section of line it should be recognized that the information available is in many cases incomplete. Further research will be necessary before a final decision can be made as to the exact location or places where the greatest damage can be done with the least effort.

3. Military Traffic Potential as Affecting the Value of Specific Lines. - Seventy-five to one hundred trains are required to transport a fully equipped division. Information secured from operating railroad managements in the United States and Great Britain indicates that in Western Europe the following scale of line capacities should be allowed for:

Double track electric	96 trains per day
Double track steam	75 trains per day
Single track electric	36 trains per day
Single track steam	30 trains per day

Trains per day refers to the number in each direction and a volume of traffic which can be maintained.

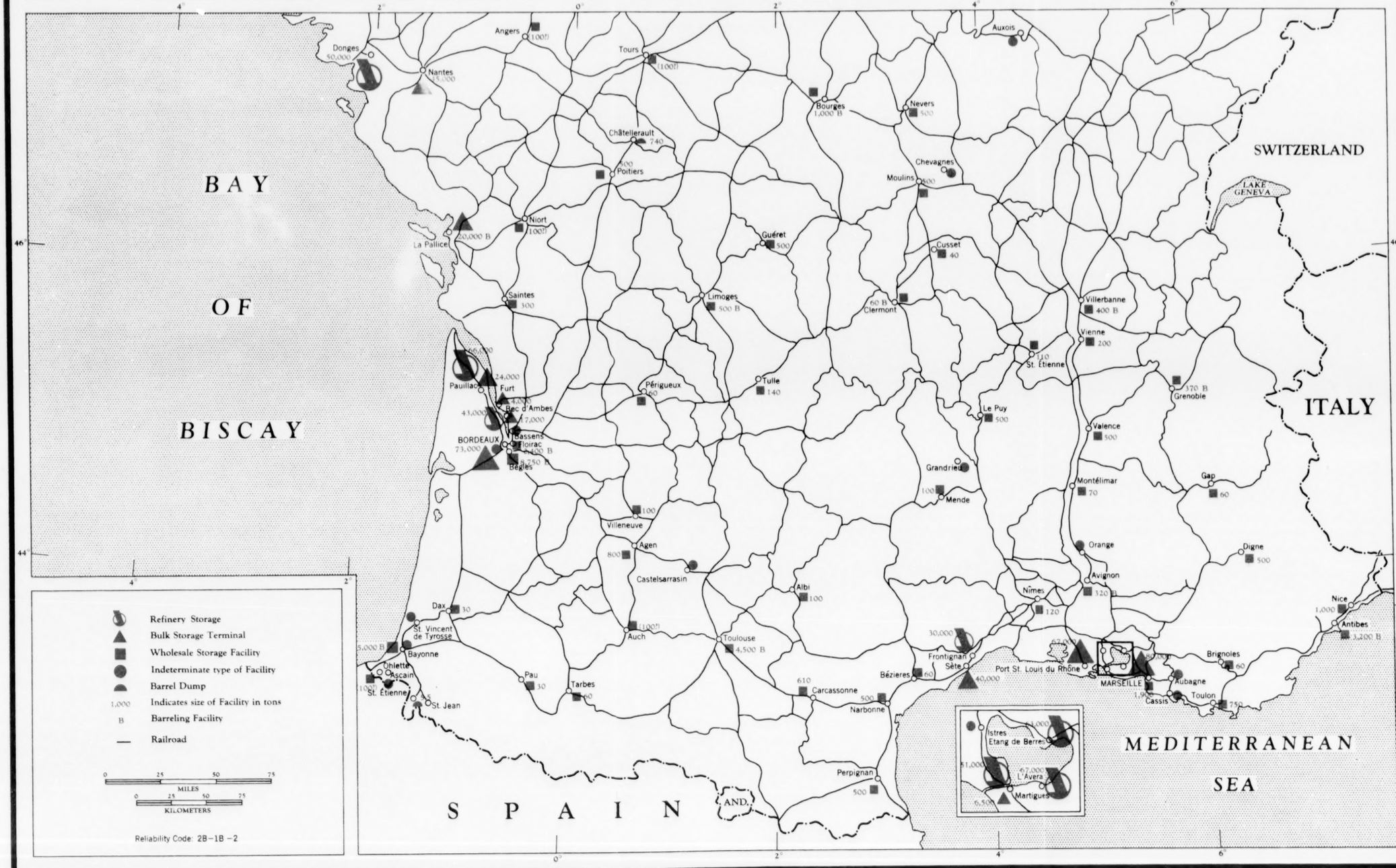
It is clear that many of the single track branch lines in Southern France would not be able to carry the same length and weight of train as the main direct lines. Length of sidings and in some cases lighter rails and weaker bridges would compel the use of shorter trains and lighter locomotives.

Consequently the usefulness of certain of the branch lines would be less than a mere consideration of their routes would indicate. It would be a mistake, however, to leave such lines out of consideration in determining a plan of attack as even the worst of them would be able to handle very substantial military traffic.

Due to its large size, the following document has been filmed in segments. The order of the segments is as follows: left to right, top to bottom.

SOUTHERN FRANCE: PETROLEUM FACILITIES

JUNE 1943



MAP NO. 2446
3 JULY 1943

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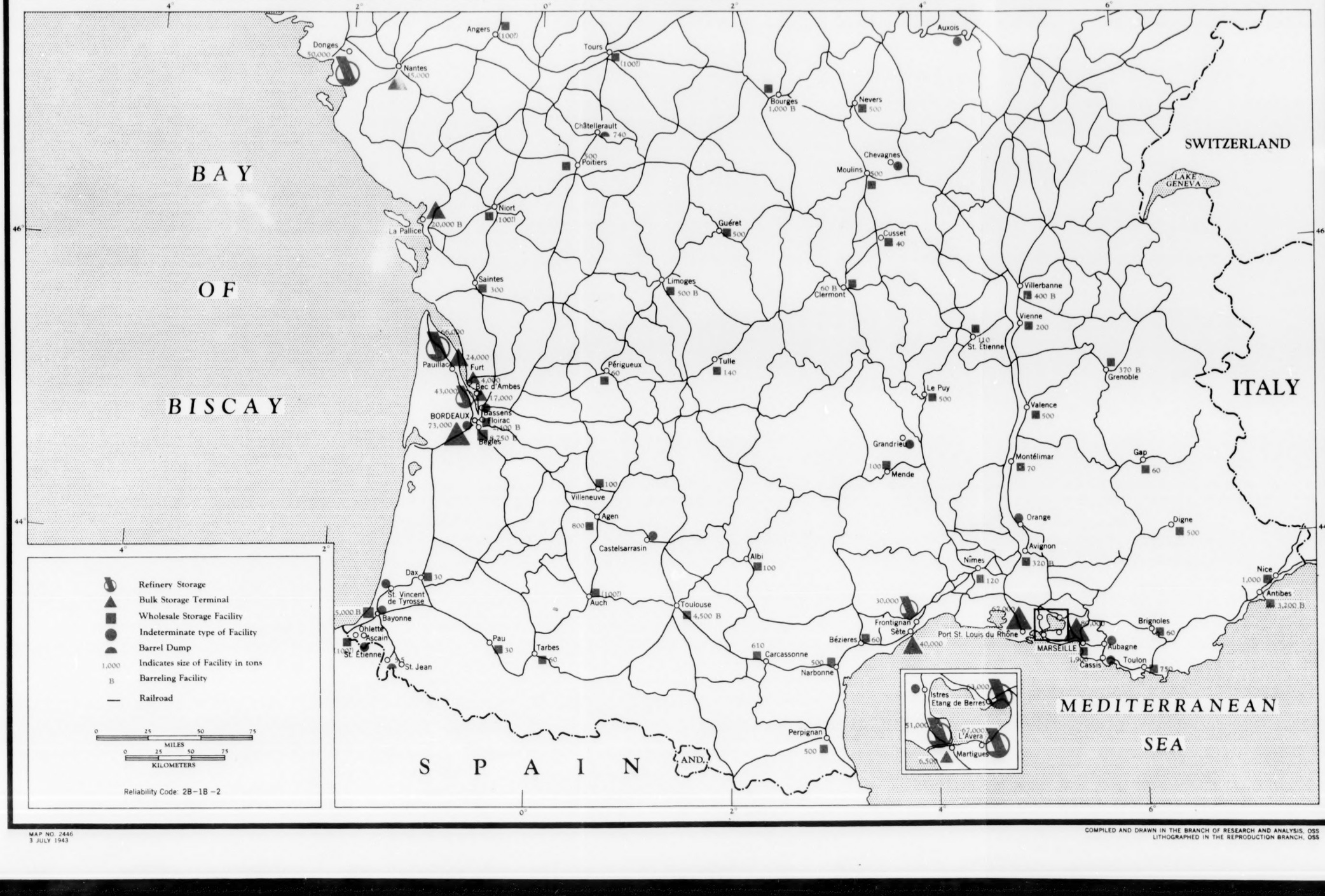
SOUTHERN FRANCE: PETROLEUM FACILITIES

JUNE 1943



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SPECIAL OPERATIONS TARGETS -- SOUTHERN FRANCE

MUNITIONS DUMPS

1. General Strategic Significance.

The fundamental importance of ammunition and explosives to all military operations is too obvious to require discussion.

2. Strategic Theory

Selection of Target Systems among Ammunition Dumps.

While no exact figures are available there is general agreement that the German capacity to product ammunition and explosives to meet existing requirements and provide for very substantial stock piling is ample. The pattern of munitions storage is not a hard and fast one which can be described with certainty. In general it may be said that there will be supplies in the hands of forward troops, advance dumps somewhat further back and somewhat more concentrated, and intermediate dumps generally at points well located for the transportation of supplies to any one of a number of points which might be threatened and main rear bases. In addition, there are large reserve supplies stored in Germany itself.

In view of the ample manufacturing capacity and large accumulated reserve, the value of any munitions dump in France will depend upon its time and place utility rather than upon the absolute quantity of material it contains. To

111

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put the matter in extreme form, it would be more useful to deprive the front line troops of ammunition for a day at the time of invasion than to destroy two weeks' supply at a main rear base. Either amount could be replaced by the enemy without very much difficulty. In one case, replacement would probably come too late. In the other case it could be effected before the operations of front line troops were hampered.

Ideally then, for D-Day operations, attacks on munitions dumps should be confined to those in the forward areas, and effort which might be expended against rear dumps should be turned instead toward the destruction of transportation facilities which would be used to bring up supplies not only from the rear dumps which might otherwise be destroyed, but from alternative sources of supply in Germany itself.

The systems set out below have been chosen with an eye to destroying ammunition supplies which might be expected to be drawn upon relatively soon in case of invasion operations in certain coastal areas. It must be recognized that these systems have been selected on the basis of data which is incomplete and unsatisfactory. Further intelligence from the field should certainly be sought.

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SYSTEM I.

Mediterranean Coastal Dumps East of the Rhone

Six targets, listed in tentative order of their importance.

1. Miramas (near Marseilles in the Parque Monteau): Explosive Dump. Large store of explosives in some 70 sheds built into the hills. Map included. This is a former French army dump. (The information in regard to this antedates German occupation).

2. Marseilles at Stade Velodrome: "Important ammunition depot."

3. Toulon Arsenal: "Main base for the French fleet. Large stores of ammunition and powder were kept here." Intelligence indicates that these were not destroyed at the time of the scuttling of the French fleet and presumably the facilities are being used by the enemy.

4. Cassis: "Munitions and gas (?) poison gas (?) gasoline (?) dump.

5. Bandol: Villa of Mjardillier. "Munitions depot."

6. Martigue near Aix: "Ammunition depot."

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SYSTEM II

Avignon - Nimes Area

From their location one would judge these to be forward reserve dumps. They are located in the area of the junction between the north-south and east-west main railway lines. These supplies could be moved rapidly to the Mediterranean coast either east or west of the Rhone.

Two targets:

1. Large ammunition dump, capacity 3,000 tons: east of Remoulins between the road and the River Gard.

2. Munitions Depot at a former powder factory: Nimes - Avignon road.

The food and equipment depots at Pont St. Esprit and Nimes (La Place Antonin) might also be included in this system although they probably do not contain munitions.

SYSTEM III

Mediterranean Coast west of the Rhone

Two targets:

1. Soual, 12 kilometers west of Castre. Large ammunition dumps in which 400 soldiers were working early in 1943.

2. Soual-Chateau de Rod: On the Soual-Revel road seven kilometers from Soual. Constructed in the woods andwell camouflaged. "Large munitions depot" probably containing bombs.

It is possible that #1 and #2 are the same.

114
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3. Polilles: Near the road from Port Vendres to Banyuls, - explosive factory with large underground stores

SYSTEM IV

Southern Biscay Coast

Five targets:

1. St. Jean de Luz: Between St. Etienne de Baigorry and St. Jean de Luz is a war material depot constructed by the Todt organization in natural caves.

2. Ammunition dump on Route #117 between Arteville and the junction of the Dax-Port du Lauc road, three kilometers from Peyrehorade.

3. Munitions dump at Peyrehorade hidden under pine trees.

4. Ammunition dump and gas (gasoline ?, poison gas ?) depot, St. Vincent de Tyrosse, approximately 100 meters from crossing of roads from Josse and St. Geours.

5. Citadelle appears to be used as an ammunition dump.

SYSTEM V

Bordeaux Area

Two targets:

1. Munitions depot on left side of the railway connecting Bordeaux and Bayonne, 20 kilometers from southern edge of Bordeaux.

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2. Vaires, about 28 kilometers from Libourne. Four munitions dumps. (Apparently French army dumps since information is for the period prior to the Occupation).

SYSTEM VI

Perigueux Area

Three targets:

This area contains intermediate depots well located for rapid transportation to the French Atlantic Coast between the mouth of the Loire and the Spanish border.

1. Explosives factory between Bergerac and Couze, 10 kilometers east of Bergerac. In December 1942, 1500 tons of C.P. in silos and 15,000 tons of "poudre B" in quarries at Couze and gravel pits under water.

2. Munitions depot at St. Astier near Perigueux.

3. Bergerac: Arms and equipment depot.

SYSTEM VII

St. Nazaire - Nantes Area

Two targets:

1. Large munitions depot between St. Nazaire and Mean.

2. Ammunition dump in the forest of Gaure near Nantes (map is available.)

There are known to be numerous depots in the zone of the interior. For the reasons stated above, it is not recommended that these be considered as targets unless railway

attack is deemed more difficult.

Russell Dorr

June 3, 1943

117
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ZONE OF THE INTERIOR

For the reasons stated above, depots in the zone of the interior are not entitled to high priority as targets. The following list may be of assistance particularly when the zone of active fighting moves northward.

Dates are those when the reports containing the information were received.

1. Bois de Tete. Ammunition dump, second largest in Occupied France, 150 separate dumps each 25-30 meters in diameter. Located in woods at Ternay between Thouais and Loudon at a place called Bois de Tete. (Maps and details of layout are available.) 11/12/42

2. Bordeaux. Gare Etat Marchandises Quai Des Champs. Food depot for all of La Gironde, a part of Landes and of Charentes. Barbed wire surrounds it and there is unused AA post in court yard of station. It was guarded by 6 soldiers at the beginning of 1943. 24/2/43

3. Salbris. Camp Salbris, near Salbris and Orleans-Vierzon railroad. Dump for mines and shells. Two hundred and fifty Germans were stationed here in 1942. Map and suggestions for means of attack available. 15/7/42

4. St. Amant de Boixe (Charente). Important dump probably munitions. Camouflaged and hidden in woods. 1943

118

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5. Perigueux. Big ammunition dump in huge caverns. Two hundred meters from Abbaye de Bromstone. Twenty kms. from Perigueux. 1943

6. Bron (Rhone). Munitions dump, one of the most important in the district. 15/1/43

7. Clermont. Atelier de Chargment des Gravanches Clermont. Munitions stocks.

Cartridges of 75 FA 18	46,214
105 Sch. shells	31,229
105 1935 "	50,483
105 1937 "	1,690
75 AM 1915 shells	5,986
75 AM 1917 "	699
75 FA 1918 "	131,512
Special bombs of 90(I)	2,565
" " " 50 kg.	5,256

21/3/43

8. Clermont-Ferrand. Store of 300 tons of explosives at Crouelle Powder Factory. 31/12/42

9. Roanne. Arsenal and dumps. Formerly used to store French army vehicles. Seven buildings, formerly garages and shops. In January 1943 the arsenal contained 600,000 rifles, 30,000 Hotchkiss M.G., 25,000 sub-M.G. 1924 model, 220 75 mm. cannon and 500 ambulances. One hundred cars and trucks belonging to French Armistice Army. 1943

10. Besancon. Important arms dump located at Ft. St. Benoit. Six to 10 Germans in charge, in November 1942. 12/ 42

11. Nantes. Ammunition dump and depot of 1,000 kg. bombs. Located on road to Bouaye from Nantes beyond the Nantes Chateau-Bougon airdrome. (Defenses listed.)15/10/42

119

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12. Fontenay Le Comte. Ammunition dump. Near railroad station left of the railroad line leading to Tours. 8/42

13. Tournay. Ammunition dump located in forest of Tournay. 8/42

14. La Ferte-Hauterive (near Moulins). Munitions dump. 18/11/42

15. St. Loup, near Roanne. Arms and equipment depot. 18/11/42

16. Chateauroux. Munitions depot 40 km. north of town. 18/11/42

17. Dijon. Bomb depot near the airdrome. Camouflaged with trelliswork, covered with grass, leaves, etc. 15/10/42

18. Bourges. Powder arsenal. 15/10/42

19. Aiguebelle Monastery. Arms dump. 5/10/42

20. Les Vanneaux. Munitions dump. (Map included.) 2/43

21. St. Vincent de Tyrosse (Landes). Ammunition dump and gasoline depot near St. Vincent de Tyrosse, approximately 100 meters from crossing of roads from Josse and St. Geours. 1943

22. La Chapelle. Munitions dump. Station for dump is at Mathieu. 3/3/43

Due to its large size, the following document has been filmed in segments. The order of the segments is as follows: left to right, top to bottom.

PROVISIONAL EDITION

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SOUTHERN FRANCE
NATIONAL RAILROAD FACILITIES

Multiple Track Standard Gauge Railroad — Electrified
Double Track Standard Gauge Railroad — Electrified
Single Track Standard Gauge Railroad
Single Track Narrow Gauge Railroad

Classification Yard
Switching Yard
Major Repair Shop
Running Repair Shop
Power Station
Sub-Station
Transformer Station
Roundhouse
Boundary of Report Area

Reliability Code: 1A-1A-2

BORDEAUX

LYON

MARSEILLE

KILOMETERS

MILES

MAP NO. 2316
24 MAY 1943

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PROVISIONAL EDITION (First Revision)

CONFIDENTIAL

RAILROADS OF SOUTHERN FRANCE

Reliability Code: 1A-1A-1

	NATIONAL RAILROADS		MAJOR PRIVATE R.Rs.
Multiple Track-Standard Gauge		Electrified	
Double Track-Standard Gauge			
Single Track-Standard Gauge			
Single Track-Narrow Gauge			

Boundary of Railroad Systems Prior to Consolidation (Midi, État, Orléans, Paris-Lyon-Méditerranée)

Boundary of Report Area

ÉTAT

ORLÉANS

M I D I

P. L. M.

BAY OF BISCAY

SPAIN

ANDORRA

SWITZERLAND

ITALY

KILOMETERS 0 25 50 75

MILES 0 25 50 75

MAP NO. 2317
REVISED 14 JULY 1943

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REPRODUCED IN THE REPRODUCTION SECTION, OSS

PROVISIONAL EDITION

CONFIDENTIAL

RAILROADS OF SOUTHERN FRANCE

Reliability Code: 1A-1A-1

	NATIONAL RAILROADS		MAJOR PRIVATE R.Rs.
		Electrified	
Multiple Track - Standard Gauge	═══	═══	═══
Double Track - Standard Gauge	═══	═══	═══
Single Track - Standard Gauge	───	───	───
Single Track - Narrow Gauge	- - - -	- - - -	·····

Boundary of Railroad Systems Prior to Consolidation
(Midi, État, Orléans, Paris-Lyon-Méditerranée)

Boundary of Report Area

KILOMETERS 0 25 50 75

MILES 0 25 50 75

MAP NO. 2317
REVISED 14 JULY 1943

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REPRODUCED IN THE REPRODUCTION SECTION, OSS

PROVISIONAL EDITION (First Revision)

RESTRICTED

FRANCE
NATIONAL RAILROADS

MILES 0 25 50 75

KILOMETERS 0 25 50 75

Reliability Code: 1A--1B--2

0° 2° 4°

48°

46°

BELGIUM

GERMANY

SWITZERLAND

ITALY

BAY OF BISCAY

Dunkerque
CALAIS
Anvers
BOULOGNE
Hazebrouck
TOURCOING
ROUBAIX
Desvres
Étaples
Montreuil
Bethune
LILLE
Hasnon
Wallers
Haveluy
Bruxelles
Odomez
Valenciennes
Liége
St. Pol
Arras
Douai
Abbeville
Doullens
Villers au Tertre
Aubigny-au-Bac
Cambrai
Wassigny
Hirson
Bruxelles
Mers
Le Treport
Dieppe
St. Valery en Caux
Fécamp
Etretat
AMIENS
Péronne
St. Souplet
St. Quentin
Liart
Mézieres
Charleville
Sedan
Rethel
Montmédy
Thionville
Coblenz
Cologne
Liége
Cherbourg
Borneville
Neufchâtel
Yvetot
Buchy
LE HAVRE
Villebonne
Caudebec en Caux
ROUEN
Sotteville
Beauvais
Clermont
Laon
Soissons
Neuilly
Bayeux
CAEN
Trouville
Oissel
Lisieux
Gaillon
Aubevoye
Vernon-Eure
Senlis
REIMS
Challerange
Verdun
Briey
METZ
Mannheim
Wissembourg
Karlsruhe
Sarrequemines
Regneville
Granville
Mutrecy
Pontoise
ST. DENIS
Meaux
Château Thierry
Épernay
Roscoff
Lannion
Paimpol
Londerneau
BREST
Guingamp
St. Brieuc
St. Malo
Avranches
Romagny
St. Hilaire du Harcouet
Argentan
PARIS
Trappes
Le Perray
VERSAILLES
Épernay
Rambouillet
Maintenon
Coulommiers
Châlons
Revigny
Bar le Duc
Marbache
Commercy
Toul
Dieulouard
NANCY
Sarrebourg
Saverne
Igney
Vendenheim
Avricourt
STRASBOURG
Erstein
Sélestat
Ste. Marie Aux Mines
Colmar
Vitry le Frois
Nançois Tronville
Châteaulin
Quimper
Lorient
Auray
Vannes
Ploermel
RENNES
Vitré
Laval
Alençon
Mortagne
Charbonnières
Étampes
Corbeil
Melun
Montereau
Sens
TROYES
Montargis
Neufchâteau
Chaumont
Mirecourt
Épinal
Langres
St. Florentin
Tonnèrre
Auxerre
Gien
Châteaubriant
Sablé
LE MANS
Châteaudun
ORLÉANS (Les Aubrais)
Vendôme
Blois
ANGERS
TOURS
St. Nazaire
Paimboeuf
Pornic
NANTES
Les Laumes Alésia
Blaisy-Bas
Clamecy
Cosne
Vierzon
Vesoul
Lure
Belfort
MULHOUSE
BÂSLE
1914 BOUNDARY ALSACE - LORRAINE
Gray
Gurney
DIJON
Labarre
BESANÇON
François
Arc-Senans
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Neuchâtel
Loudun
Bressuire
La Roche sur Yon
St. Gilles
Les Sables d'Olonne
Parthenay
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Le Blanc
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Pte. de Grave
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St. Gervais les Bains
Ruffec
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Marennes
Saintes
Angoulême
Buisseau Sur Creuse
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Eygurande Merlines
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ST. ÉTIENNE
Brioude
Le Puy
St. Flour
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Mt. Cenis Tunnel
Briancon
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Blaye
Bec d'Ambes
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Libourne
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Terrasson
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Condat
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Seilhac
Viescamp
Le Buisson
BORDEAUX

PARIS AND ENVIRONS

Montsoult Maffliers
Pontoise
Mantes
Meulan
Poissy
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St. Germain
Plaisir Grignon
Asnières
Puteaux
St. Cloud
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Boissy
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Vincennes
Versailles
Trappes
0 6 MILES
0 10 KILOMETERS

LEGEND

MULTIPLE TRACK
STANDARD GAUGE

DOUBLE TRACK
STANDARD GAUGE

SINGLE TRACK
STANDARD GAUGE

SINGLE TRACK
NARROW GAUGE

ELECTRIFIED LINES ARE SHOWN IN RED

BAY OF BISCAY

SPAIN

SWITZERLAND

ITALY

MEDITERRANEAN SEA

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Ploermel
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Épernay
Coulommiers
Esternay
Sens
TROYES
Montargis
LE MANS
Sablé
Château-dun
ORLÉANS
(Les Aubrais)
Vendôme
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ANGERS
TOURS
St. Florentin
Tonnèrre
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Blaisy-Bas
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Largentière
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Figeac
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Campagnac
Rodez
Millau
St. Jean du Gard
Alès
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Plaisance
Bédarieux
Castres
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Auch
Montauban
Beaumont
Agen
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Port St. Marie
Monsempron-Libos
Cahors
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Le Buisson
Périgueux
Terrasson
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Brive
Argentan
Seilhac
Uzerche
Meymac
Ussel
Eygurande
Merlines
LIMOGES
Le Mont Dore
Lacueuille
CLERMONT-FERRAND
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Épinal
Nancois Tronville
Marbache
Commercy
Toul
Dieulouard
NANCY
Sarrebourg
Saverne
Igney Avricourt
Vosges Tunnel
St. Dié
Ste. Marie Aux Mines
Sélestat
Ersteinc
STRASBOURG
Colmar
Belfort
MULHOUSE
Vesoul
Lure
BASLE
BESANÇON
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Arc-Senans
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Neuchâtel
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Bourg St. Maurice
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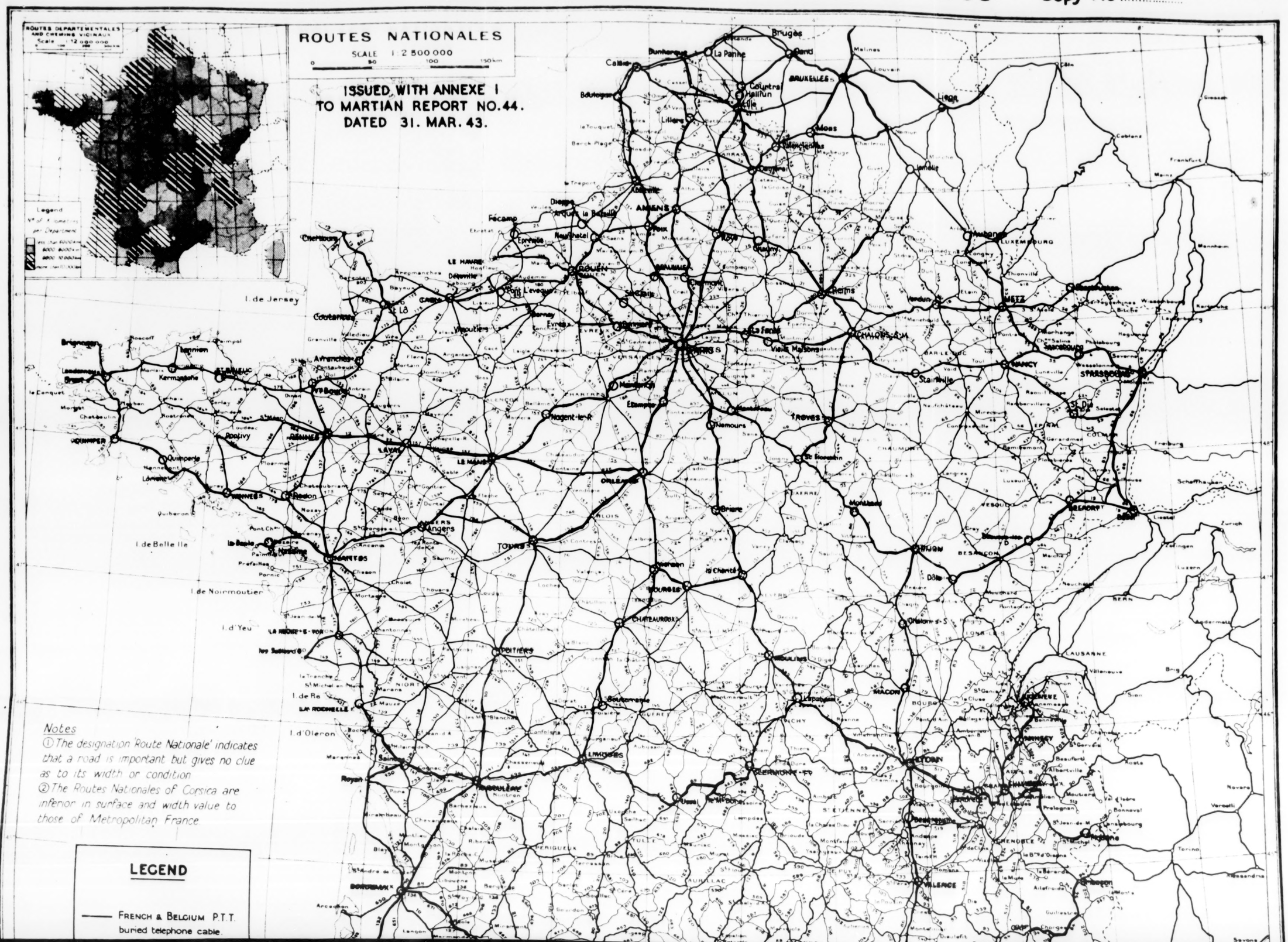
Beaujeu
Cours
Trévoux
LYON
Givors
Vienne
ST. ÉTIENNE
Roanne
Riom
Volvic
Manringues
Thiers
Gannat
Vichy

LONG DISTANCE TELEPHONE CABLES

FRENCH 'ROUTE NATIONALE' SYSTEM in 1935

MOST SECRET
Copy No. 95


ROUTES DEPARTEMENTALES AND CHEMINS VICINAUX
Scale 1:2 000 000
ROUTES NATIONALES
SCALE 1:2 500 000
0 50 100 150km
ISSUED WITH ANNEXE I
TO MARTIAN REPORT NO.44.
DATED 31. MAR. 43.
Legend
I. de Jersey
I. de Belle Ile
I. de Noirmoutier
I. d'Yeu
I. de Re
I. d'Oleron
Notes
① The designation 'Route Nationale' indicates that a road is important but gives no clue as to its width or condition
② The Routes Nationales of Corsica are inferior in surface and width value to those of Metropolitan France.
LEGEND
FRENCH & BELGIUM P.T.T. buried telephone cable.
Brugès
Dunkerque
Calais
Boulogne
La Panne
Gand
Malines
BRUXELLES
Courtrai
Hellfun
Lille
Liège
Liége
Maas
Aix-la-Chapelle
Cologne
Frankfurt
Mainz
Mannheim
Arras
Abbeville
AMIENS
Dieppe
Arques
Le Bastille
Fécamp
Etretat
Eprville
Rouvillet
Cherbourg
LE HAVRE
Honfleur
Deauville
Bayeux
Caen
Pont L'evêque
ROUEN
Elbeuf
Evreux
Vernon
Meulan
Chartres
Dreux
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Fontainebleau
Melun
Provins
Sens
Joigny
Auxerre
Troyes
St Florentin
Reims
Rethel
Sedan
Mezières
Charleville
Montmédy
Verdun
METZ
Thionville
LUXEMBOURG
Longwy
Arlon
Metz
Sarreguemines
Sarrebourg
Phalsbourg
Saverne
Wasselonne
Molsheim
Schirmeck
Lagarde
Bruyères
Epinal
Remiremont
Gérardmer
Colmar
Ribeauvillé
Sélestat
Strasbourg
NANCY
Lunéville
Toul
Commercy
Bar-le-Duc
Ligny
Void
Stainville
St Dié
Raon-l'Etape
Senones
Fraize
Provenchères
Gérardmer
Munster
Colmar
Ribeauvillé
Sélestat
Freiburg
Schaffhausen
Zurich
Luzern
Basel
Liestal
Delémont
Porrentruy
Montbéliard
BELFORT
Belfort
Vesoul
Gray
Dôle
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Pontarlier
Neuchâtel
Bern
Lausanne
Vevey
Villeneuve
Sion
Brig
Domodossola
Novara
Vercelli
Torino
Savona
Aosta
Albertville
Modane
Briançon
Gap
Digne
Grasse
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Saumur
Angers
Segré
Châteaubriant
Redon
Vannes
Quiberon
Quimperlé
Lorient
Quimper
Pont-Croix
Douarnenez
Audierne
Pont-Labbé
Concarneau
Rosporden
Quimperlé
Pontivy
Loudéac
Dinan
Dol
Fougères
Vitré
Laval
Mayenne
Le Mans
Alençon
Mortagne
Argentan
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Lisieux
Pont-Audemer
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Beauvais
Compiègne
Soissons
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Maubeuge
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Hesdin
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Doullens
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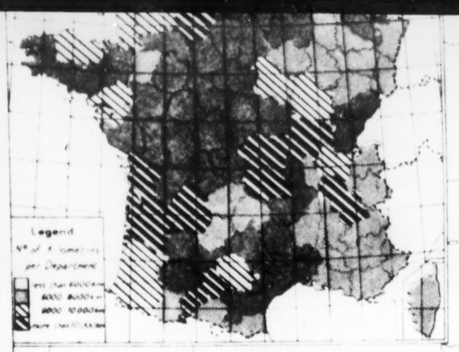
Tonnerre
Joigny
Migennes
Montereau
Corbeil
Etampes
Dourdan

ISSUED WITH ANNEXE I
TO MARTIAN REPORT NO.44.
DATED 31. MAR. 43.



Notes

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② The Routes Nationales of Corsica are inferior in surface and width value to those of Metropolitan France.

LEGEND

- French & Belgium P.T.T. buried telephone cable.
- German Extensions to cable network
- o Repeater Stations

HOME FORCES No 56 (From ATLAS de FRANCE No 54) 100 5/43 523 R.E./632

SECRET

OFFICE OF STRATEGIC SERVICES
Research and Analysis Branch

SEP 1943

SPECIAL OPERATIONS TARGETS - SOUTHERN FRANCE

TELECOMMUNICATIONS

(Revised)

1. General Strategic Considerations Concerning Attack on Telecommunications. Communication of orders and information is essential to military operations. The German army uses telephone, radio and telegraph for this purpose. It is equipped, particularly when fighting in sparsely settled areas, with mobile radio and field telephone equipment. In well-settled areas such as France where the civil communications system is highly developed, the large bodies of enemy troops stationed there tend to rely, particularly for long distance messages, largely upon the civilian communications facilities, supplemented by fixed military installations. In France and Belgium the actual and anticipated demands of military traffic are such that the German army is reliably reported to have already preempted all but a few of the many long distance telephone circuits. In a period of large scale military movements which would accompany an invasion, it seems fair to conclude that not only military but civilian telecommunications facilities would be used to their utmost capacity by the Wehrmacht in directing movements of troops and supplies.

SECRET

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SEP 1943

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(Revised)

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It must be recognized that means will be found to get high priority messages through regardless of successful operations against fixed telecommunications facilities. However, the communications load of the large bodies of enemy troops in France will be much heavier than that of the few divisions which were served successfully by their own equipment in the North African campaign. Moreover, it is doubtful whether troops equipped for campaigning in Europe will have the same relative amount of communications materiel as the Afrika Korps. Reduction of the available telecommunications capacity to a small fraction of its normal figure at the very moment when demands on it are greatest can be expected to increase enemy logistic difficulties and thereby to interfere seriously with his military operations.

2. Strategic Value of Different Types of Fixed Telecommunications

a. Conclusion. After consideration of target possibilities in the telecommunications field in Southern France the conclusion has been reached that no effort by SO against radio or telegraph facilities in the area would have as much effect on enemy communications as an equal effort against long distance telephone installations. If such installations were eliminated, however, telegraph facilities would still be able to carry a considerable number of messages. For this reason, and because both

types of installations are often to be found in the same building, the telegraph system should be the second priority target of SO operations against telecommunications.

b. Discussion of Types of Facilities

i. Radio. It is reported that the German army in the West makes practically no use of radio for military communications, relying instead on the telephone. Radio installations are independent rather than inter-dependent. Even if the many commercial stations were knocked out, military transmitters and receivers would still be available.

ii. Telephone. The German army in France is reported to be relying almost exclusively upon telephone communication and, as noted, has virtually preempted long distance lines. That the marked advantages of security, flexibility, and reliability of the telephone network are recognized by the German military authorities is attested in several ways. The German authorities have taken control of the French telephone exchanges and repeater stations and have set up an organization to control and maintain the long distance network. They have laid telephone cables of their own, some paralleling the French telephone cables, some providing lateral communications where none existed before. It is reported that there is a new telephone cable running along the coast from Dunkerque to Biarritz and another from Marseilles to the Italian border,

a considerable part of which has in each case been installed by the Germans. Recent air reconnaissance shows scores more short cables all along the coast of France connecting flak batteries, observation posts, and other elements of the coastal defense system with sections of the long distance telephone lines. It seems obvious that in the event of an Allied invasion the telephone cables will be called upon to carry the main bulk of the emergency load.

The telephone system itself must be subdivided for target purposes into the long distance underground cable network (including supplemental sections laid by the German military), the long distance circuits impressed on high tension electric transmission lines, the local network, and the military field telephones.

The underground cable network can carry by far the greatest volume of messages and is therefore entitled to first priority in the general campaign against telecommunications. In France the long distance cables are typically composed of a number of quads (double pairs) of conductors each of which is capable of carrying simultaneously at least 40 to 50 messages. The number of quads in the main line runs between 75 and 110. Others have 45 to 60, while those connecting less important points may have from 7 to 25.

Long distance telephone lines imposed on high-

tension power transmission lines in Southern France can, as presently equipped, carry only 4 to 10 messages at a time. Local and long distance lines are not normally interconnected with power line circuits. Such connections could be made by the use of certain complicated equipment, but it is believed that such equipment is not available in substantial quantity. The power line circuits are so inferior in carrying capacity to the long distance underground cables that operations against them could not be recommended as part of a general campaign unless the long distance telephone and telegraph lines had first been disposed of.

A few long distance circuits might be pieced together out of local circuits in an emergency, but each circuit would carry but one message at a time and signals would be weak and indistinct. Moreover the local telephone network is too complicated and dispersed and too easily supplemented by ordinary military field telephones to be profitably attacked as part of a general campaign.

Military field telephones would be difficult to locate and generally of local importance only. They should rank last on the list of priorities.1/

iii. The telegraph system may be expected to carry a very considerable volume of military long distance com-

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1. Of course, the isolation of some particular point, as opposed to an area, might require operations against power and local lines and military field telephones.

munications and if the telephone system were put out of commission additional emergency traffic would be handled. It is not unusual to put 20 message channels (each channel carrying one message at the rate of 60 or more words per minute) on an individual telegraph wire. These messages would, of course, have to be received by teletype machines or trained operators and the number of these available would probably constitute the limiting factor on the capacity of the line. Both for its independent significance and as standby equipment the telegraph system is second only to the long distance telephone lines.

3. General Vulnerability Considerations

a. Priority List For Attack. In terms of importance of the function they perform, the order of priority for attacking installations on long distance telephone lines should be as follows: first priority, central exchanges; second priority, independent repeater stations; third priority, inductance coils; fourth priority, cables. The orders of priority in respect to complexity of equipment and repair time and in terms of importance of functions are the same. These priorities will, of course, be modified by the operational situation as is suggested in the section on Location and Accessibility.

The first attack within exchanges should be

against switchboards and cables so that even if coordinated attacks on adjacent exchanges or repeaters fail communications will nevertheless be cut. Operations against repeaters, power equipment and selectors should follow.

b. Relation of Various Installations to Functioning of System

i. The Long Distance Telephone Equipment. Central long distance exchanges perform two main functions. They constitute switching points whereby long distance and local telephone circuits are connected. They also amplify or boost through long distance messages between other points. The first function is performed by switchboards and selectors, the second by repeaters (essentially radio amplifiers). Repeater equipment is made necessary by the fading of the electric impulses coming over the wire due to distance and the resistance of the wire itself.

In the larger cities constituting the major communication centers the central long distance exchange functions may be divided among two to four exchanges. These exchanges will be cross-connected but each will normally handle traffic to and from only a portion of the total area of which the city in which they are located is the communications hub. In such cities there are usually provisions for a number of alternative routings of through traffic and for the emergency switching of calls.

Where a city has multiple central long distance exchanges only the most detailed and exact knowledge of the communication system of that particular locality will permit a statement as to which exchanges and installations are necessary to the continuance of long distance telephone traffic between any distant point and another point in or beyond the city in question. Usually technical advice will be necessary in appraising such a situation.[1] Unless such intelligence and technical advice can be secured, special operations against central long distance exchanges should be confined to single central exchange cities.

Within the central exchange the most complicated piece of equipment is the switchboard. It possesses signal lights, jacks (plugs) for making connections, headphone sets, and hundreds of wire connections. In an automatic exchange there are frames supporting hundreds of selectors. These are electrical switches which receive signals from the dials of automatic phones and which select the appropriate lines for making the connections.

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1. Care should of course be taken to distinguish between multiple central long distance exchanges and multiple local exchanges. Many towns which have a number of local exchanges have only one central long distance exchange.

Such functions are performed by operators in manual exchanges.

In each exchange there is carrier apparatus. This equipment, essentially a vacuum tube oscillator, sends out the carrier wave on which messages originating in the exchange territory are impressed.

Repeater equipment is provided for each long distance circuit. It consists of coils, vacuum tubes and switches. These may be mounted next to each other on large boards or frames, the coils contained in metal boxes and the tubes and switches exposed. Repeaters are spaced along each line about 30 to 60 miles apart. No single repeater is essential to the continued functioning of its circuit except at the end of a line since the output or "gain" of repeaters on either side of the gap can be increased to take care of the loss. If two adjacent repeaters fail to function, however, communication will be interrupted. The loss of a single repeater will weaken the signal and may make it impossible to compensate for the loss of a number of loading coils which would normally be done by increasing repeater gain.

Direct electric current at low voltage is necessary to the functioning of switchboards, selectors, and repeaters. Such power may be supplied by motor-generators

or rectifier-transformers run on outside power or by generators powered by internal combustion engines or other prime movers on the premises. There is usually standby generating equipment which can provide emergency current in case of failure of the main power supply. In addition, there ~~are~~ is customarily a set of batteries to stabilize the current and to serve as another emergency source of power. Communications system power requirements are not great and exchange power installations are therefore comparatively small. (For example, the main exchange in an important American communications center of over a million inhabitants requires only 1200 kw.)

Independent repeater stations, housed in their own structures (resembling small electric power substations in size), are placed in the open country to amplify the current wherever towns are so far apart that the repeaters in the town exchanges cannot maintain the power required by the line. Their equipment consists of a board or boards carrying the repeater coils, tubes, and switches, there being a set of these for each circuit as in the exchanges. There will also be, as in the exchanges, either a rectifier-transformer set or a motor-generator for converting outside power into the type needed by the repeater equipment, or an independently powered generator. In addition there will, in either case, generally be an auxiliary power plant for emergencies and a set of batteries

for stabilizing the current and for an additional source of emergency power.

Cables are, of course, the conductors of messages between exchanges and between exchanges and private phones. A cable consists of individual wires usually bound up in pairs or quads (2 pairs), each wire wrapped in a special kind of shellacked paper. The pairs or quads in turn are covered with a lead sheath armored with jute and a double-wrapping of steel. At regular intervals the cables are provided with loading or pupinization coils whose function is to increase the carrying capacity of the cable and to get rid of eddy currents and interference between circuits. These consist of coils with magnetically efficient cores which are interposed in the cable.

ii. The Telegraph. High capacity long distance telegraph circuits operate on the same carrier frequency principle used in telephony. A number of the conductors in lon_ distance telephone cables are usually set aside for telegraph use. Telephone power sources are used and carrier apparatus is generally located in the telephone exchange. For teletype transmission switchboards which are similar in function to telephone boards are used.

Separate carrier apparatus is required for each channel imposed on the telegraph conductor. As many as 25 messages may be carried simultaneously by a single wire.

A single unit of carrier apparatus consists of a box containing sending and receiving equipment not unlike a radio set (though the impulses emitted travel along a wire). Each message, of course, requires teletype machines or keys and trained operators at each end of the line.

iii. Power Line Circuits. It has already been pointed out that power lines are sometimes used for long distance telecommunication in addition to the regular telephone network. On such lines the only installations which are important from the communications point of view are the carrier units, the wires, and, if there are any, the switchboards. The functions performed by these installations are the same as in the case of the telegraph save that the wires carry the voice rather than code signals. ~~Power comes from the power system.~~

c. Susceptibility to Damage and Replaceability of Various Installations

i. Long Distance Telephone Exchanges. Most of the important equipment in exchanges and repeater stations is complicated and relatively light and easy to damage either with or without explosives. Switchboards could presumably be damaged by fire axes or other heavy instruments, by fire, or by small charges of explosives. The wiring is light and easily cut, though there are of course hundreds of independent conductors. In the larger exchanges a number of switchboards will serve the same lines

so that it may be necessary to deal with perhaps a half dozen parallel units in order to interrupt service.

Switchboards will ordinarilly take from two or three months to a year to replace. It is customary, however, for a telephone system to have a number of portable manually operated boards available for emergencies. Through the use of such a board partial working of the lines could be restored in a few hours but even so a very heavy reduction in capacity would be achieved.

Most of the main telephone exchanges in France are automatically operated and therefore are equipped with selectors. These switching devices are small and delicate and could be easily smashed or destroyed by small quantities of explosives. The large number of these units might complicate operations, though, as noted, they are generally mounted close together. If a great many were destroyed simultaneously, replacement would constitute a difficult problem and might require several months.

Carrier and repeater equipment is in construction essentially like radio apparatus and should be easy to damage by smashing, explosives or fire. While, as in the case of selectors, there are hundreds of repeater units, construction is probably light enough so that large numbers could be destroyed simultaneously by the use of primacord. Replacement of carrier equipment and of any considerable number of repeaters would require at least several months

once stocks of repeaters which are believed to be small were consumed. As noted above, however, the loss of a single repeater would not put a circuit out of commission.

After long distance cables are led into an exchange they are opened up and the conductors are led around inside the exchange on a series of frames. Large masses of small insulated wires are exposed and susceptible to fire and cutting. The wires are numerous and the circuits complicated but rewiring could not be counted upon to require more than a few days.

Much of the power supply equipment is of heavier construction than the exchange equipment itself but it will hardly go beyond the medium machinery class. If rectifiers are used they may be of glass rather than metal and so extremely vulnerable. Rectifiers rather than transformers should be attacked since they are more difficult to replace. Unless there is a widespread campaign against such equipment, however, spares are likely to be available.

If motor-generators are used there ~~is~~ are likely to be several parallel units, each with a capacity of at most a few hundred kw. Operators would have to be prepared to deal with shafts up to several inches in diameter, bearings, and commutator rings.

Standby generating equipment will have about the same total capacity as the regular operating plant but such capacity may be concentrated in larger units.

In the case of batteries the number of units may run into the dozens. These will be located together however, and could probably be dealt with by primacord. The casings are not normally of heavy construction.

It is impossible to state power supply replacement time categorically. In the United States collections of automotive storage batteries have been used to restore service in emergencies and presumably the same thing might be done by the enemy. In view of the high priority accorded communications, industrial installations might be raided for equipment. From the point of view of replacement time attack on apparatus peculiar to the telephone system, rather than power supply equipment, will be more effective.

ii. Long Distance Repeater Stations. The comments made above on exchange repeater equipment and power supply appl/ also to independent repeater stations.

iii. Long Distance Telephone Cables. Long distance telephone cables may be damaged by cutting, by boring through the protective covering and pouring acid into the interior of the cable and by removal of loading coils. Driving sharp metal objects such as nails or crowbars into the cables may also knock out the cable though damage may

not extend to all the conductors.

Removal of loading coils is probably the best method of operation. Removal of a single coil will have the effect of a single cut in the cable. Permament loss of a number of coils would in addition require the use of greater signal strength and would increase interference and cross talking between circuits. The latter could well become serious enough to hamper communication. Since the normal method of compensating for loss of loading coils is to increase the output of repeaters the permament removal of a considerable number of loading coils simultaneous with the destruction of a single repeater station would at least seriously reduce and would probably halt the carrying of messages.1/

There is little maintenance demand for loading coils in ordinary times. No large number of spares is therefore likely to be on hand if those on the line are carried away or destroyed.

Single cable breaks are likely to interrupt telephone transmission for only a few hours. The whole system is geared to the prompt discovery and repairing of such incidents. Apparatus exists in each exchange or repeater station for locating the position of a single break by electrical means within a few minutes. In order

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1. Further investigation is being carried on as to exactly how many coils would have to be removed to cripple a line completely.

to achieve any pyramiding of repair time it will therefore be necessary to make at least three cable breaks between each pair of repeaters. The effectiveness of the attack will be much increased if this number can be multiplied. The shortness of repair time on cables indicates that such attacks should be undertaken only after it has been decided that operations against repeater stations and exchanges in the region are impractical.

iv. Carrier Frequency Telegraph Circuits. The vulnerability of carrier equipment may be compared to that of repeaters and what has been said above on that heading will be applicable here. In regard to teletype switchboards comparison can be made with telephone apparatus with the exception that each switchboard is also equipped with a teletype machine. Such machines would of course be easy to put out of commission permamently.

v. Power Line Telephone Circuits. Carrier equipment is like telephone repeater apparatus in vulnerability but would consist of far fewer units. These are likely to be located near the telephone instrument itself. Power line conductors of course carry the telephone impulses on these circuits. While felling the pylons which carry these conductors might interrupt the use of these lines for telephone purposes for a period ranging from hours to days a rather considerable effort would be required for a comparatively small return.

Interference with the generation or transforming of the power flow would not affect power line telephone circuits.

d. Location and Accessibility of Various Installations. Central exchanges are usually located in the post office in all but the largest cities. There they may have separate structures of their own. As already suggested, it may be extremely difficult in multiple long distance exchange cities to determine into which central exchange the cable from any given point is led and consequently to appraise the importance of any particular exchange. This difficulty of course does not exist as to single central long distance cities.

Repeater equipment is placed in exchanges except, as noted earlier, where the interval between them is too great. In that case repeater equipment will be housed in a small independent station.

In France long distance underground telephone cables in open country are simply laid in the earth. They follow the main roads and are buried from 2 1/2 to 6 feet deep near the shoulder of the road. It is reported that some of the cables installed by the German army are laid on the surface of the ground.

The cables themselves are lead-covered and armored with jute and a double-wrapping of steel (presumably

wire or light strip). In inhabited localities and at road and railway crossings, special protective covering is provided.

The location of main cable lines is shown by mark-stones which except on a few lines in the north of France project 4 cm. above the ground. These mark-stones indicate the location of loading coils and splice points. The former occur at intervals of either 1850 or 850 meters. A standard loading section is reported to be composed of eight equal lengths of cable spliced together. Where loading points are more closely spaced splice points between them will of course be fewer. Mark-stones may be recognized by the letters PTT and the numbers they bear. They are numbered serially outward from Paris to indicate the number of the repeater station, the number of loading coils from the last repeater and of splicing points from the last loading coil. For example, mark-stone 224-5 on the Paris-Strasbourg line should be read (reading backwards so as to get the proper order of subordination of parts to wholes): the fifth splice (or fifth length of cable), on the twenty-fourth loading sector, between the second and third repeater stations on the line. The location of each loading coil is indicated by a mark-stone carrying a "P" in addition to the PTT and the numbers mentioned.

Telegraph equipment in France, as has been indicated, is located in telephone exchanges.

Carrier equipment used for public communication on power lines is located in the central telephone exchange in any particular town.

Attached are two maps of the French long distance underground cable system. One is a schematic representation of the network in Southern France based on information received in Washington up to May 19, 1943. This map of course does not purport to give any information as to the exact location of the cables. The second map is dated as of March 31, 1943, and purports to indicate the underground cable network of all France and the roads along which such cables are laid.

While very little information has been located which tells the exact defense measures taken to protect installations in any particular locality, it is known that in general exchanges and repeater stations on long distance lines in France are not only partially staffed by Germans but are guarded by German troops armed with rifles and machine guns. One report as of March 1943 generalizes the number as ranging from four to fifteen men per exchange. The same report indicates that large exchanges are likely to have ground floor windows blocked up and approaches to the building covered by pill boxes.

No reports have been received casting light on enemy security measures in regard to other installations.

4. Selection of Systems. Four target systems have been tentatively selected in the long distance telephone field. The basic assumption has been that there will be military operations along the Mediterranean and Biscay coast of France and that attending these there will be a large volume of the long distance telephone traffic from these coastal areas to Northern France, Italy, and Germany. Systems have been selected with the thought of securing with the least effort the maximum dislocation of such long distance telephone service.

It should be explained that in the description of each of the different systems discussed below, where the inclusive phrase, "central exchanges and repeater stations", is used in connection with the telephone installations in different cities, it does not mean that in such cases the exchanges and repeaters are in different buildings. It simply indicates that both types of equipment should be attacked in each exchange. It should be added that in the absence of specific information on each all the repeater stations listed as targets in this report are thought to be attached to exchanges.

Repeater stations along the same cable lines are listed in adjacent pairs because, as noted, an attack

on a single one will fail to tie up the line completely.

No information has been located as to which, if any, of the cities of Southern France have multiple long distance central exchange systems and which have single central long distance exchanges. In the absence of definite information, it will probably be wise to assume that the main centers, Marseilles, Lyon, Toulouse, Bordeaux, and Toulon, and particularly the first two, may have more than one central long distance exchange. Unless details can be secured as to the long distance systems in these cities it will be advisable to shift any projected attack to the nearest single exchange or repeater station center outside such a large city which will make an adjacent pair with another repeater station or exchange selected for attack.

In connection with the elimination of particular sections of line, one important difference between attacks on telecommunication systems and transportation systems must be recognized. Since telephone messages travel with the speed of electricity, no disadvantage will be imposed upon the enemy solely through having to use a roundabout route. Line priority depends entirely upon carrying capacity. Where figures are available, the number of four conductor conduits (quads) per cable is included as an indication of the relative capacity of different lines.

High-tension power lines used for telecommunications in Southern France are shown on the map attached to this report. They are not made part of the target systems, however, because their capacity is so limited that they would only be worthwhile objectives in isolating some particular point.

SYSTEM I

Strategic Significance. Successful attack on this target system would cut off all regular long distance telephone communication between points in the areas of the French Mediterranean coast, the Pyrenees, and Biscay south of Gironde, and the rest of France and Italy.

Description of System

1. Telephone Cable Lines Between Bordeaux and the North. Bordeaux-Poitiers, 115 kms. 110 quads and 2 pairs for radio transmission. Bordeaux-Limoges, 250 kms. 110 quads and 2 pairs for radio transmission (4). Bordeaux may be a multiple exchange city and therefore impractical to attack because of the complexity of the system. If it develops, however, that it is a practical target, it should be paired with Angoulême and Montpon and given first priority. If it is not a practical target, first priority should be given to the central exchanges and repeater stations in smaller communities along both long distance cable lines to the

north. On the Angoulême line it would be necessary to attack the central exchanges and repeater stations in Angoulême, Poitiers, and Limoges simultaneously. On the Bordeaux-Brive-Limoges line, if it has been completed, first priority should go to the central exchanges and repeaters at Limoges and Brive because Limoges is the junction point of two important lines. The central exchanges and repeater stations at Montpon and Perigueux should have second priority.

2. Two Telephone Cable Lines Between Avignon and Lyon, 210 kms. Cable I, 91 quads. Cable II, 89 quads and 2 pairs used for radio transmission. Lyon may be a multiple exchange city and therefore not practicable to attack. If, however, it should turn out to be a practical target, it should be paired with Péage and given first priority. Because of its strategic location on the Mediterranean coastal cable lines, Avignon may also be a multiple exchange city. If it is found to be a suitable objective and Lyon is not (Avignon being a smaller city than Lyon), Avignon should be paired with Danzère and given first priority. If both Lyon and Avignon can be made targets, the former together with Péage should be given first priority and the latter together with Danzère should be given second priority. If neither is a practical objective the elimination either of the central exchanges and repeater

stations at Valence and Danzère or those at Valence and Péage would halt long distance telephone communication between Avignon and Lyon. Priorities as between these alternatives should be assigned in the light of the operational situation at the time of attack rather than on the basis of other considerations.

3. Telephone Cable Line Between Marseilles, Toulon, and Menton, 195 kms. Marseilles-Cannes, 75 quads; Cannes-Menton, 91 quads. Toulon and Marseilles may both have multiple exchange systems. If, however, they are found to be suited to SO operations, they should be given first priority and attacked simultaneously. If Toulon can be attacked but Marseilles not, Toulon should be paired with Vidauban and given first priority. Otherwise top priority should go to the central exchanges and repeater stations at Vidauban and Cannes. Any of these alternatives will interrupt long distance telecommunication with Italy.

SYSTEM II

Strategic Significance. Successful attack on the targets listed would eliminate regular long distance telephone communication between the Mediterranean coastal area and the rest of France. It would be supplemental to an invasion of the Mediterranean coast rather than of both coasts.

Description of System. This system will consist of virtually the same targets as System I, except that for the

two or possibly three lines north of Bordeaux, the Toulouse-Narbonne line is substituted.

1. Telephone Cable Line Between Toulouse and Narbonne, 140 kms. 73 quads and 2 pairs used for radio transmission. Toulouse is an important junction point for two trunk lines but may be a multiple exchange town. If made a target, it should be paired with Carcassonne and given first priority. Otherwise, first priority on this line should be given to the central exchanges and repeater stations at Carcassonne and Narbonne.

2. Two Telephone Cable Lines Between Avignon and Lyon, 210 kms. Cable I, 91 quads; Cable II, 89 quads and 2 pairs used for radio transmission. As noted above, Lyon may be a multiple exchange city and therefore not practicable to attack. If, however, it should turn out to be a practical target, it should be paired with Péage and given first priority. Because of its strategic location on the Mediterranean coastal cable lines, Avignon may also be a multiple exchange city. If it is found to be a suitable objective and Lyon is not (Avignon being a smaller city than Lyon), Avignon should be paired with Danzère and given first priority. If both Lyon and Avignon can be made targets, the former together with Péage should be given first priority and the latter together with Danzère should be given second priority. If neither is a practical objective the elimination either of the central exchanges and repeater stations

at Valence and Danzère or those at Valence and Péage would halt long distance telephone communication between Avignon and Lyon. Priorities as between these alternatives should be assigned in the light of the operational situation at the time of attack rather than on the basis of other considerations.

3. Telephone Cable Line Between Marseilles, Toulon, and Menton, 195 kms. Marseilles-Cannes, 75 quads; Cannes-Menton, 91 quads. As noted above, Toulon and Marseilles may both have multiple exchange systems. If, however, they are found to be suited to SO operations, they should be given first priority and attacked simultaneously. If Toulon can be attacked but Marseilles not, Toulon should be paired with Vidauban and given first priority. Otherwise, top priority should go to the central exchanges and repeater stations at Vidauban and Cannes. Any of these alternatives will interrupt long distance telecommunication with Italy.

SYSTEM III

Strategic Significance. Cutting off telecommunications between the Biscay Coast south of the Gironde and the rest of France.

Description of the System

1. Telephone Cable Line Between Dax and Bordeaux, 135

kms. 110 quads and 2 pairs for radio transmission (plus 46 quads and 2 pairs, Pau-Cajeres). As noted before, Bordeaux is probably a multiple exchange city. If it is to be made a target at all it should be paired with the central exchange and repeater station at Labouheyre. Otherwise, priority one would be the central exchanges and repeater stations at Dax and Labouheyre. If it is practicable to attack a line so near the coast, either alternative would cut off communications in the coastal area between the Gironde and the Spanish border.

2. Telephone Cable Line Between Toulouse and Narbonne, 140 kms. 73 quads and 2 pairs used for radio transmission. As aforementioned, Toulouse is an important junction point for two trunk lines but may be a multiple exchange town. If made a target, it should be paired with Carcassonne and given first priority. Otherwise, first priority on this line should be given to the central exchanges and repeater stations at Carcassonne and Narbonne.

3. If it is felt impossible to attack section 2, the two cable lines between Bordeaux and Toulouse and Dax and Toulouse could be substituted. There would undoubtedly be some advantages to cutting off Toulouse from the Biscay Coast to be weighed against the increase in the number of operations necessary. If this alternative is decided upon, the priorities should be as follows:

a. Telephone Cable Line Between Bordeaux and Toulouse, 215 kms. If it proves at all practicable to attack the multiple exchanges at Bordeaux or Toulouse, Bordeaux should have first priority, Toulouse second, either one being paired with Agen. Otherwise, priority one should go to the exchange and repeater station at Agen and attack on this station should be coupled with extensive damage to the Bordeaux-Toulouse cable line.

b. Telephone Cable Line Between Dax and Toulouse, 260 kms. If Toulouse is a practicable target, it should be paired with Cazeres and given first priority. Otherwise, priority one would be the central exchanges and repeater stations at Dax and Tarbes. In this case, second priority would be the central exchanges and repeater stations at Cazeres and Montrejeau.

SYSTEM IV

Strategic Significance. Successful attack on this system would cut off the Rhone Valley and Southeastern France from direct communication with Italy.

Description of System. The importance of the system, however, is low as long as connections through Northern France are unimpaired. The necessity for routing calls in roundabout fashion which would follow from its elimination does not impose serious disadvantages in point of time and the

effect of the attack will only be that of reducing the number of lines available to carry the traffic.

1. Telephone Cable Line Between Lyon and Modane, 170 kms. Lyon-Chambery, 128 quads; Chambery-Modane, 48 quads. If it proves feasible to attack the multiple exchange system of Lyon, such an attack should be coupled with operations against Les Arbets, both together being given first priority, and Les Arbets and Aiguebelle second. If Lyon cannot be attack, first priority goes to the central exchanges and repeater stations at Les Arbets and Aiguebelle. In such a case, second priority goes to the central exchanges and repeater stations at Modane and Aiguebelle.

2. Telephone Cable Line Between Marseilles-Toulon-Menton, 195 kms. Marseilles-Cannes, 75 quads; Cannes-Menton, 91 quads. As noted before, Toulon and Marseilles probably have multiple exchanges. If they can be attacked, they should have first pirority. Otherwise, top priority goes to the central telephone exchanges and repeater stations at Vidauban and Cannes.

Intelligence Required

It should be recognized that the above selection of targets is tentative. Further intelligence is needed on the following points:

1. Exact location and identifying characteristics of exchanges and repeater stations.

2. Approachability of particular installations assigned top priorities.

3. Which cities are multiple exchange cities together with details of the installations in and interrelations of the different exchanges.

4. The type of power used in each of the exchanges and repeater stations including information as to:

a. whether the power comes from outside;

b. what, if it does, is the nature of the auxiliary power -- e.g., diesel, gasoline, together with nature and capacity in kw of the auxiliary generators;

c. how power from outside is transformed into the type needed by the exchange equipment -- e.g., by generators, by rectifier-transformers, etc;

d. whether batteries are used, and, if so, whether as standby equipment, as a stabilizer of other power, or whether as the main power for the exchange.

5. The message capacity of the telegraph lines which run between the same points as the long distance telephone lines listed under the different target systems.

6. The size and location of stores of strategic equipment possessed by the telephone system in Southern France.

7. Further information as to networks, particularly military telephone cables which may have been laid when the Germans moved in in November 1942, and submarine coastal cables.

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SPECIAL OPERATIONS TARGETS - SOUTHERN FRANCE

WATER SUPPLIES

General Strategic Considerations - Attacks on urban water supplies must be evaluated from the point of view of causing disruption of road and rail transport in the area immediately surrounding the city attacked. Southern France is sufficiently well watered so that there can be no hope of depriving enemy military forces of necessary water supplies.

Possibilities of depriving large urban centers of water seem to be considerable. Reserve accumulations in reservoirs within many of the main cities would be sufficient for only a day or two at normal rates of consumption. Serious damage to aqueducts and pumping stations which could not be made good before reservoirs ran day might be expected therefore, to cause large scale evacuations. These would cast heavy burdens upon road and rail transport in the vicinity of the waterless city. The military difficulties caused by throwing thousands of refugees upon the roads in the campaign in Belgium and France in 1940 is well known. It must be recognized, however, that the effect might be different in the proposed case. In 1940 French and British troops were hampered by the movements of a friendly population. Their willingness to take drastic measures to open up the roads was therefore undoubtedly limited. It is likely that the Germans would hardly be squeamish in their treatment of a hostile population under similar circumstances.

SECRET
181

The existence of alternative sources of water supply sufficient for military use indicates that our own invading forces would probably not be greatly hampered by the destruction of urban water supplies. By the time our troops moved in, evacuations would probably have been completed. It is also likely that the damage would have been at least partially made good. If it is thought likely that the enemy will resort to similar demolitions before withdrawal, it will be much better to accomplish the destruction ourselves. This will throw the burden of evacuation on the enemy and save our own forces from the hampering effect. On the other hand, consideration will have to be given to the possible unfavorable effect of facilitating German kidnapping of French labor by forced evacuations. *

To the extent that the civilian population has already been evacuated from the city selected before D-Day, the significance of urban water supplies will decline.

2. Basis of Selection of Recommended Targets

The water supply systems of seven cities in southern France have been selected as possible target systems. The selection has been made on the basis of the importance of each city as a possible defense point or transportation center. Only those cities have been selected which have comparatively large populations, are dependent on a single or a small number of sources of water supply and have a small reserve of water in urban reservoirs.

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* Possible unfavorable effects on the attitude of the population toward the United Nations resulting from destruction of water supplies need not be taken too seriously since it would be likely that the enemy could carry out a similar demolition before withdrawal in any event.

122

SECRET

SECRET

3. **Target Systems**

Toulon Comment on the significance of this port and naval base to an invading force is superfluous. Population in 1931 was about 148,000. In 1931 Toulon and its suburbs, including La Seyne, consumed 28,000 cubic meters of water per day for all purposes. Total available supplies during the dry season, which extends from the end of May to the end of September, were on the order of 36,500 cubic meters daily. Impairment of the ozone plant at the Dardennes dam would cut off 28,500 cubic meters of the supplies then available and attack on the pumping station at the lower St. Antoine reservoir would account for most of the remainder. Installations for an additional daily supply of 13,000 cubic meters were projected in 1931 and have probably been completed. Information as to the vulnerability of these installations is not at hand, but there is no reason to suppose that they were constructed with an eye to military safety.

Marseillle The enemy would presumably try to hold on to this important point as long as possible. The population in 1931 was about 652,000. As of 1931 Marseille was supplied with between 860,000 and 1,200,000 cubic meters of water per day. These quantities were considered inadequate but nothing appears to have been done to increase them. The installations seem to present good opportunities for attack as water is brought in by an aqueduct 92 kilometers long which passes through no less than 84 tunnels and over 11 bridges. As there are five reservoirs in or near the city,

183
SECRET

SECRET

there might be as much as 500,000 cubic meters on hand, depending partly on where the long supply line could be cut. Details as to exact location of tunnels and bridges are not yet available, but it is unlikely that the quantity in storage could last for more than 24 hours unless strict rationing measures were instituted.

Bordeaux The city whose population in 1931 was about 256,000 is not only the most important French Biscay port but a vital rail and communications center. Daily water consumption in 1927 was 55,300 cubic meters. This figure was roughly the same as that for delivery capacity in 1931. There has been some thought of enlarging the system, but there is no evidence that this has been done. The entire supply could be cutt off by cutting the 12 kilometer aqueduct from St. Medard to the Pauline reservoir, the 41 kilometer aqueduct from Budos to the Bequet reservoirs, and the pumping stations at Cap Roux reservoir. Instead of the two aqueducts the pumping facilities at Bequet and Pauline could be substituted as objectives. The contents of the reservoirs in and about the city would not be affected by these measures. Theoretically this would mean that 49,000 cubic meters, or something less than a day's supply would still be available, but towards the end of the summer the reservoirs hold much less than capacity.

Nimes This city is significant as a German divisional headquarters. It is an important junction between north-south and east-west rail lines. Its population in 1931 was approximately 84,000. In 1927 Nimes consumed an average of 26,350 cubic meters Rhone water per day. A fountain within the city provided another

124

SECRET

SECRET

800,000 cubic meters deily during the wet season but only 800 during the dry season. Rhone water is obtained at Camps where there is an electric pumping station from which two conduits 25 kilometers long lead to three reservoirs, with a total capacity of 19,900 cubic meters, located within the city. Thus if the pumping station at Camps were attacked during the dry season, the city would have available less than a day's supply of water, at normal consumption rates.

Sete This is the third port in importance on the French Mediterranean coast. Population of only about 37,000 suggests that it might be difficult to cause an evacuation of significant proportions. In 1927 this town consumed on the average 7,400 cubic meters of water per day. The daily capacity of the supply system four years later was about 9,000 cubic meters. The entire supply could be cut by destruction of the aqueduct, ten kilometers long, which brings the water from Issanka in the Vienne valley; the greater part could be cut by knocking out the two pumping stations at the Quai de Moulins. Water stored in the four reservoirs at Moulins would not, however, be affected by these actions, so that an outside limit of 14,500 cubic meters, or about two days' supply at normal consumption rates would still be on hand.

Avignon This city is a key junction between the Rhone Valley and Mediterranean coast rail lines. Its population in 1931 was about 51,000. In 1927 the city consumed 6,630 cubic meters of publicly supplied water a day, all of which was obtained from wells within the city, put through an ozone plant with a daily capacity of 8,640 cubic meters in 1931 and pumped to three reservoirs

SECRET

with a total capacity of 7,490 cubic meters. The system could be put out of operation by destruction of the pumping equipment, the steam engines held in reserve as well as the electric motors, and the reservoirs drained by breaching the ascension channel.

Alternative supplies from 50 public and some 2,000 private wells which existed in the city in 1931 might well limit the effectiveness of these actions.

Bayonne Population in 1931 was about 41,000. This city and three neighboring villages received 6,000 cubic meters of water daily as of the summer of 1931. If the villages and the Adour forges be excluded, Bayonne itself consumed 3,560 cubic meters daily. The water is supplied by an iron pipe 25 kilometers in length leading from the mountains south southeast of the town.

4. Matters to be Investigated Further

The above selections are tentative. Further research is required on the following points:

1. The extent to which normal consumption of water can be cut without compelling large scale evacuation. Presumably this percentage will be considerably lower than that which would obtain in the United States or even in England. English experience in the blitz may be suggestive. The population of southern France undoubtedly does not use as large quantities of water per capita and quantities used in washing and bathing are undoubtedly much smaller.

2. The data from which points of attack have been

SECRET

chosen are over ten years old and should be supplemented.

3. The possibility of rapid development of alternative sources of supply must be considered further.

Russell H. Dorr
2 June 1943

OFFICE OF STRATEGIC SERVICES

Research & Analysis Branch

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SPECIAL OPERATIONS TARGETS - SOUTHERN FRANCE

ELECTRIC POWER

1. General Strategic Considerations - Electric power generating stations and transmitting networks in southern France are not entitled to high priority from the standpoint of military importance. The main power load consists of industrial consumption and military effects through factory shutdowns achieved by attack on power would be extremely long term, certainly on the order of more than a year. Civilian lighting and urban street railway traction consume substantial quantities of power. Lack of domestic lighting and urban civilian transit could hardly affect direct enemy military capabilities in the area cut off and street lighting would be turned off in any case.

It is possible that widespread industrial shutdowns and lack of urban transportation facilities caused by lack of electric power might contribute to civilian unrest and cause confusion at the time of an invasion. It is believed, however, that the same amount of effort devoted to attack on more vital civilian services such as water supplies would be more effective for this purpose.

Certain uses of power do have some military significance. Searchlights, radar stations, telephone and telegraph, heavy coast defense guns, certain water supply installations all use electricity The amounts of power required for operation of the military

SECRET

equipment are comparatively small and can easily be provided by the mobile generators with which modern armies are equipped. While commercial telephone and telegraph and water supply facilities might not be serviced by military generators it would be illusory to suppose that the entire commercial power facilities including emergency standby stations could be so completely crippled that the small quantities of power required for this purpose could not be furnished.

Electrified main line railways in southern France consume considerable quantities of power. Cutting off electricity supplies would have a temporarily disorganizing effect on traffic. However, it could not be expected that rail movement would be halted completely for more than a very short time since there are about 3,000 steam locomotives available in the area and others could soon be brought from northern France, Italy and Germany. It is impossible to state exactly how long traffic would be completely stopped, but it seems highly probable that an equivalent effort directed against engineering structures on the right-of-way would produce a more complete and longer continued traffic block.

In spite of the fact, therefore, that the electric power system of southern France could be put out of operation by simultaneous attacks on a dozen or so key transformer and switching stations and one or two generating plants, it is recommended that power targets be omitted from the list of

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Special Operations objectives in this area except insofar as they are necessary to the high tension telephone circuits discussed under communications targets.

Russell H. Dorr
8 June 1943

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SPECIAL OPERATIONS - SOUTHERN FRANCE

INLAND WATERWAYS

There are three inland waterways of main importance serving Southern France. These are the Rhone, including its network of artificial channels in the delta region, the Rhone-Sete Canal and the Midi-Garonne Lateral Canal.

1. The Rhone. The Rhone waterway is a main transport artery between Lyon and the French Mediterranean coast. Barge shipments of oil are the most significant present traffic. There are no locks or other engineering works in the area between Lyon and the delta which might be targets for special operations. Even if the three locks between Bouc and Arles were destroyed, the main part of the haul would have been accomplished and the significance of a successful attack would therefore be slight.

2. Rhone-Sete Canal. This waterway affords a facility for the transport of bulk commodities along the western Mediterranean coast in protected waters. From a military point of view, its main use would be in the transport of oil, particularly barges which might already be in position at the time of an invasion. The waterway is paralleled by roads and an adequate rail line and while its one lock at Aigue Mortes might be attacked, the enemy would not be much embarrassed thereby.

3. Midi-Garonne Lateral Canal. There are more than 200 locks on this waterway so that it is obvious that no very rapid movement of traffic is possible. The only military significance of the waterway would be in case reconnaissance indicated the presence of barge storage of oil or military supplies at conveniently located points. Vulnerability would appear to be high.

67

SECRET

Section 8

Line: Limoges - Coutras

Target Section: Coutras to Junction near Mussidan (approx. 40 kms)

As indicated in the text, this steam line has importance greater than is indicated by its relative capacity. It provides a convenient by-pass for north - south traffic, connecting, as it does, with the Paris - Brive - Toulouse line at both Brive and Limoges. It was formerly a double-track line from Limoges to Coutras, but the Germans have ripped up one of the tracks for use elsewhere. This is the only line in Southwestern France where this practice has been noticed.

The stretch for special operations was chosen with a view toward cutting off access to the Villeneuve-sur-Lot - Angouleme line, a north-south by-pass of low capacity. Data concerning the location of engineering works has been accumulated in the British Handbook, but is unavailable to us at the present time. The line travels along the Isle River from Coutras to Mussidan and beyond. It crosses this river at St.Medard-de-Guixieres and again at Mussidan. This latter bridge, however, is slightly East of the junction with the southern by-pass and slightly West of the junction with the northern by-pass. It is not recommended as a target, therefore, since traffic could be routed into the line by means of the Villeneuve-sur-Lot - Mussidan stretch.

68

SECRET

Section 9

Line: Morceux-Tarbes

Target Section: Mont-de-Marson to Riscle (48 Km.)

This single track steam line provides a convenient substitute link between the southern Biscay coastal area and the main Bayonne-Tarbes-Toulouse line, joining with it at Tarbes and, by a more roundabout route, at Toulouse. There is a double-track section from Vic-Bigorre to Tarbes (18 kms.). The maximum grade is from one half to one percent. The maximum permissible axle load is 18 tons.

The section to be attacked is 48 kms. in length and follows the River Adour, crossing it and its tributaries several times. There are 17 bridges as follows:

Distance from Mont-de-Marsan (in kms.)	Location of Bridges
34-42	Bridge over the River Lin.
42-48	Bridge over the River Jarras. Bridge over the River Pesque Bridge over the River Adour.
0-14	Three bridges over tributaries of the River Adour.
14-23	Bridge over a tributary of the River Adour.
23-32	Three bridges over tributaries of the River Adour.

42-48	Bridge over a tributary of the River Pesque. Bridge over a tributary of the River Adour.
14-23	Bridge over a river.
34-42	Bridge over a river.
0-14	Two bridges over small rivers.

Details of length, height and character of structure are lacking.

SYSTEM III

Section 10

Line: Morcenx-Port Ste. Marie

Target Section: Gabarret to Nerac (approx. 40 kms.)

This low capacity by-pass could be used to route traffic from the Paris-Hendaye line, which it joins at Morcenx, to the Toulouse-Bordeaux line, which it joins at Port Ste. Marie. Various other second class by-passes could be used for similar purposes were this section not cut. There is no information as to bridges and tunnels except that there is a bridge over a river just east of Poudenas about 10 kms west of Nerac.

Section 11

Line: Bordeaux-Falgueyrat

Target Section: Eymet to Falgueyrat (approx. 20 kms.)

This minor section must be attacked in order to prevent traffic from the east from reaching Bordeaux, either by means of the Toulouse-Bordeaux line which is joined at Marmande, or directly over this single track steam railroad. There is no information as to engineering works. However, it is apparent that the rail line crosses the Dropt River at Eymet.

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Section 12

Line: Bordeaux-Libourne-Souillac

Target Section: Bergerac to Libourne (approx. 70 kms.)

This single-track steam line provides a low-capacity by-pass between the Paris-Brive-Toulouse line at Souillac or Cazoules and the Paris-Hendaye line at Libourne. There are no data as to engineering works, except that there are bridges at La Monzie and St. Foy-la-Grande.

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SYSTEM IV

(two targets)

DETAILED ANALYSIS

Section 1

Line: Genoa-Vintimille-Menton-Marseille

Target Section: Cannes-la-Bocca to Nice (32 kms.)

This is the most direct of three lines connecting Italy with the French Mediterranean Coast. In the event of an invasion of the latter prior to a United Nations occupation of Northern Italy, German and Italian forces would undoubtedly make heavy use of this route. Insofar as Italian troops may be expected to oppose an invasion of Southern France, the line is of particular importance.

The two coastal lines merge at Nice and from Nice to Cannes-la-Bocca no standard gauge by-passes are available. The section of line which has been selected for attack therefore is between Nice and Cannes-la-Bocca.

This section of line is double track and steam operated. The maximum permissible axle load is 18 tons. Maximum grades are 1/2 to 1 percent.

While some information is available on the engineering structures along this section of line, no

details are at hand as to the length or height of these structures. The following schedule of target priorities is therefore tentative.

1. Bridges:

   Over River Brague -- 13[1/]

   Over River Loup -- 18

   Over River Valvan -- 20

   Over River Cagnes -- 20

   Over River Vaux -- 21

   Over River Magnan -- 28

   Over arms of River Var -- 23

   Bridges over streams - 6, 12, 17, 22, 26

2. Tunnel:

   Approximately 1 km. long. Branches into two double track tunnels where the lines to Vintimille and Breil separate, the former continuing along the coast and the latter running northeast.

Section 2

Line: Modane-Montmelion

Target Section: Modane-Montmelion (Approximately 80 kms.)

The significance and capacity of this railroad was described in the text. The following targets are suggested, although lack of information on size and construction makes the priority listing highly tenta-

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1/ Figures indicate kilometers from Cannes.

tive.

1. Bridges:	Distance from Montmelion (in kms.)
Over River Gelon	16
Over River Arc	27, 61, 64, 64, 71, 75, 76
Over River Bugeon	45
Over River Arvan	57
Over tributaries of River Isere	14
Over tributaries of River Arc	47

2. Tunnels: (figures indicate distance from French entrance to Tunnel-du-Mt. Cenis, on the Italian border)

Tunnel-du-Mt. Cenis -- 0

Tunnel 1.5 kms. long -- 55

Tunnel 1 km. long -- 24

Other tunnels -- 7, 27, 25

Various shorter tunnels

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SOUTHERN FRANCE

SPECIAL OPERATIONS PLAN - OIL STORAGE

1. Strategic Significance

a) Oil in General. Oil ranks with munitions and food as a military supply item of prime importance. It is consumed in large quantities in front line fighting by aircraft, tanks and trucks and is vital to the quick movement of men and materiel from inactive areas to active ones. It is estimated that a typical German motorized division consumes about 100 tons per day in active defensive fighting.

b) Significance of Various Types of Installations

1. Importance of Production Transport and Storage and Distribution. For D-Day operations, petroleum products production will be of no importance since supplies variously estimated at from 250,000 to 400,000 tonnes are already in storage in France ready for use by Axis forces.

For the same reason, the importance of oil transportation facilities from the rear to forward areas will be secondary. However, in the transportation field, particularly in the forward areas, chances to attack railway tank cars which generally move in groups and oil barges should be sought for. Rail tank cars will be especially valuable since their burning will damage the road bed and perhaps destroy other rolling stock.

Tank cars and barges are targets of opportunity which can only be covered by a general directive.

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Oil storage on the other hand will offer many significant targets. It must be recognized that it is unlikely that attacks could be so widespread and successful as to cause a destruction of enemy oil supplies extensive enough to increase substantially the tightness of the overall enemy oil position. However, the ready availability of material already in France in areas convenient for quick transportation to the battle front will give material in storage there the utility beyond its absolute value. Successful attack on tankage will also have the useful effect of causing delays in the unloading of material in transit and of forcing the enemy to reorganize lines of supply for particular units.

ii. Significance of Types of Storage Facilities - If ready availability and significance to the distributing system rather than size are accepted as the criteria of importance for oil storage, certain judgments as to the relative significance of different types follow.

In general, attack should be confined to those installations as to which there is a fair prospect of securing complete destruction. It may therefore be necessary to give a low priority to large

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terminals and tank farms and refinery storage unless long continued access can be had with considerable number of men. The loss of even 10 tanks out of 40 at a terminal will be small in terms of the total amount available to the enemy and will neither deprive the enemy of substantially all oil supplies at the particular place where the terminal is situated nor deny to him tankage for unloading and distributing purposes at that point.

Another strategic consideration contra-indicating attack on terminals is that these will undoubtedly be subjected to large scale air attack. This will be particularly true in Southern France where the terminals are located directly on or within a few miles of the coast.

The relatively small wholesale bulk stations which in normal times constitute the intermediate distribution system between the large terminals and the retail filling stations are of considerable strategic significance since they are generally small enough to be completely destroyed by a few men and yet large enough to form substantial links in the enemy's chain of supply. Certain of these wholesale bulk stations have barreling facilities. These, of course, are of particular importance. Wholesale bulk stations

SECRET

might also be considered in ordinary circumstances more important than large terminals in the short run in that they are nearer the front lines in terms of the chain of supply. However, in Southern France where the tank farms are mainly located on the coast this will not necessarily be true.

Top priority should probably be accorded to barrel and package.dumps. These represent storage in its most mobile form for military purposes. The factor of loss of permanent facilities is also present in that German resources of barrels are believed to be limited.

Barges used for the transport or starage of oil are entitled to equal priorities with barrel and package dumps. It is likely that the enemy is using barges as mobile storage along the Rhone-Sete Canal and possibly the Midi Canal. The mobility of such storage makes it particularly useful.

c) Significance of Various Types of Products - Opportunities to pick and choose between attacking storage of one kind of product and storage of another are not likely to be frequent. Where such a choice is available aviation gasoline is obviously entitled to first attention. High-grade lubricants

SECRET
90

for aircraft and tank engines are a close second though they are more difficult to ignite than other products. Motor fuel and diesel oil for trucks and tanks should rank third and heavier products such as fuel oil a poor last.

d) Significance of Location Factors. The criterion of time and place utility has already been laid down as governing the selection of types of installations to be attacked. It is primarily applicable in determining the regions in which storage should be attacked.

The greatest returns will obviously come from attacking forward supply dumps on which the enemy will draw immediately upon invasion. Loss of all supplies at these points will affect enemy fighting strength at once even though amounts destroyed are small. For this reason storage in the coastal areas is entitled to top priority rating even though it may be difficult to come at.

Storage in areas between the forward coastal areas and the nearest points designated for railway attacks should have second priority. Loss of stocks in this area will greatly enhance the effect of any railroad blockage achieved.

Storage on the far side of possible railway blocks will ordinarily decrease in importance with the

success of blocking operations. However, where such storage is well situated for emergency transport into the coastal areas by barge or truck its importance will be enhanced.

2. Vulnerability and Approachability Factors.

a) General

Oil installations are generally highly vulnerable to sabotage. As far as demolition is concerned, large holes can be blasted in tanks, important valves can readily be destroyed and small quantities of contaminants will impair the usefulness of materials stored in underground tanks. With the exception of lubricating oil, the product is highly inflammable.

Commercial bulk storage installations are rather widely dispersed and are likely to be located in districts approach to which would not be too difficult. At the large terminals, tanks are scattered over wide areas. There should be many opportunities for inside jobs in regard to commercial installations since the Germans have generally pursued the policy of continuing to use the normal French operating personnel.

b) Terminals

From the point of view of total destruction, the large terminals and refinery tank farms offer many difficulties. There will normally be up to 25 to 50 separate tanks in the former, and upwards of 100 in the latter. Most of these will be individually protected against the spread of fire by blast walls and embankments. Each will therefore constitute an individual point of attack. All large terminals will be protected by elaborate chemical and steam systems for fighting fire which, if not successfully attacked, would cut down the chances of starting a conflagration and increase the chances of salvage.

While the dispersion normally present offers advantages in accessibility as far as any one tank is concerned, it also increases the problem of destroying the whole installation. "Inside" assistance, providing intelligence as to the location of various types of stocks, the arrangement of valves and tanks, and furnishing guides or more active cooperation at the time of the actual operation would be almost indispensible to a successful attack. Even with such assistance, most elaborate plans would have to be worked out, taking into account wind direction, location of the storage of different types of products, and so forth. It would probably be necessary to use both in planning and

in directing the execution of such plans individuals skilled in the operation of such facilities. If these conditions were fulfilled, probably a dozen to two dozen men could accomplish such a mission. If they cannot be fulfilled, larger numbers of men would be required.

While most important large oil storage installations are now well protected against blast damage and spread of fire, it is probable that in general they will be more easily attacked by air than from the ground.

c) Wholesale Bulk Stations - Wholesale bulk stations offer ideal targets since the tanks are usually not only on the surface but generally elevated above the ground on comparatively light structures and are ordinarily close together. At many bulk stations, setting one tank on fire would probably result in the destruction of all. Foam and steam lines which are generally run to each tank in a large terminal are unlikely to be present. Bulk storage stations are usually too small in area to offer attractive air targets.

d) Barrel and Package Dumps - These dumps generally consist of piles of barrels and cans. Setting alight a number of units at points around the edge would easily accomplish destruction of the whole pile.

 SECRET
94

3. Selection of Target Systems - The above considerations have determined the selection of target systems for special operations against oil installations. A detailed description of the procedure adopted in selecting target systems follows.

a) Location Groupings. Installations have been grouped into systems according to location in relation to possible invasion plans. For an invasion of both the Mediterranean and Biscay coasts simultaneously, a system has been established consisting of groupings of facilities in the Mediterranean coastal area, in the Biscay coastal area, in an intervening area south of the railway attack points listed for this same operation, and finally in the area north of such points.

For an invasion of the Mediterranean coast a system has been set up containing groupings for the Mediterranean coastal area about 50 miles deep, for an intermediate belt 75 miles deep, back of the coastal zone, and for the balance of the area of Southern France.

For an invasion of the Biscay coast alone a third system has been set up on the same basis as the second except that the starting area is the Biscay coastal zone.

b) Priorities within Groupings. Within each locational grouping barrel and package dumps have been assigned top priority because they represent military

oil supplies in their most mobile form.

Only a tentative priority can be assigned between intermediate bulk storage and the large terminals until more is known of the possibilities of destroying a very large percentage of the tankage at such terminals. As noted a low percentage of destruction of the facilities at any given location will result in failure to achieve the main objective of attack i.e. denial of all products and tankage to the enemy at that particular spot. Since large terminals seem to be difficult to destroy (entirely apart from their location in coastal areas) they have been given third priority in spite of their capacity.

Facilities in each functional grouping have been assigned priorities which attempt to give weight to location factors and capacity. As to wholesale bulk storage, the presence of barreling facilities has also been considered.

SECRET

SYSTEM I

Attack on Both Coasts Simultaneously

Priority A - Coastal Areas

Group I - Mediterranean from coast to approx. 50 miles inland

1. Barrel Dumps

None identified.

2. Wholesale Storage

a. Antibes - Bulk storage and barreling depot; 3200 tonnes

b. Marseille - 1900 tonnes

c. Nice - 1000 tonnes minimum, probably more

d. Toulon - 750 tonnes

e. Narbonne - 500 tonnes

f. Perpignan - 500 tonnes

g. Avignon - Bulk storage and barreling depot; 3200 tonnes.

h. Carcassonne - 610 tonnes; on main electrified line from Toulouse

i. Digne - 500 tonnes

j. Nimes - 120 tonnes

k. Beziers - 60 tonnes

l. Brignoles - cap. 60 tonnes

3. Terminal and Refinery Storage

a. Sete (Balarouc) - Bulk storage terminal 40,000

b. Frontignan - refinery tank farm 90,000 (one-third for finished products)

c. Marseille - 4 bulk storage terminals; 23,000; 44,000; 6,250; 6,500.

d. Port St.Louis du Rhone - 3 bulk storage terminals; 9,000; 36,000; 22,000.

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e. L'Avera - refinery tank farm 200,000 (1/3 for finished products).

f. Etang de Berres - refinery tank farm 190,000 (1/3 for finished products).

g. Martigues - refinery tank farm 152,000 tonnes (1/3 for finished products); bulk storage terminal 6,500.

4. Indeterminate

The following are variously given in S.I. materials as "dumps" or "depots" without specifying whether the product is packaged in any way.

a. Aubagne - Dump 2 kilometres before arriving at Aubagne from Marseille.

a. Cassis - Dump along Mediterranean Coast.

b. Orange - Small dump; town on west Rhone railroad.

c. There is a report of a reserve on 120 railroad tank cars at Istres, each containing 10,000 litres. This would, of course, be a highly mobile form of reserve, but the proximity of Istres to the tank farms at Marseille and Port St. Louis du Rhone makes it doubtful that the report is referring to anything more than petrol in transit rather than a permanent reserve.

Group II - Atlantic Coast to 50 miles Inland, North as far as Railway Attack Points North of Bordeaux.

1. Barrel Dumps

a. St.Etienne - Dump between St.Etienne (at Pyrenees) and St. Jean de Luz. Gas stored in 200 kg. metal drums; 5,500 kg. total stock Febr. 1.

2. Wholesale Storage

a. Begles - 8,750 tonnes. Has barreling facilities.

b. Bayonne - 5,000 tonnes. Has barreling facilities.

c. Floirac - 2,400 tonnes. Has barreling facilities.

d. Dax - 30 tonnes.

98
SECRET

e. Pau - 30 tonnes.

f. Ohlette - Underground petrol reservoir between Ohlette - St. Jean de Luz

3. Terminals and Refinery Storage

a. Pauillac - refinery tank farm, 197,000 tonnes (1/3 finished products); bulk storage terminal 24,000

b. Bordeaux - bulk storage terminals; 32,500, 6,175; 3,500; 12,700; 14,800; 3,500

c. Bec d'Ambes - refinery tank farm 129,000 (1/3 finished products). Bulk storage docks 17,000 tonnes

d. Furt - bulk storage terminal - 4,000

4. Indeterminate

a. Ascain - dump 3 kms. east of Ascain on road to Ohlette

a. Bayonne -

a. Bordeaux

b. Paludate

c. St. Vincent de Tyrosse - 100 meters from crossing of roads between Josse and St. Geours.

d. Bassens

PRIORITY B - Area Between Rear of Coastal Area and Points of Railroad Attack

1. Barrel Dumps

None identified

2. Wholesale Storage

a. Toulouse - 4500 tonnes capacity. Has barreling facilities

b. Agen - 800 tonnes

c. Albi - 100 tonnes

SECRET

d. Montelimar - 70 tonnes

e. Villeneuve - 100 tonnes

f. Mendes - 100 tonnes

g. Tarbes - 60 tonnes

h. Auch - capacity unknown; town on junction of 3 single track lines

3. Terminals and Refinery Storage

None

4. Indeterminate

a. Castelsarrasin - On main railroad

SECRET

Priority C - Remainder of Area (roughly to the line of the Loire)

1. Barrel Dumps

   a. Chateleraut - 100 piles of fifty 200 litre petrol containers.

2. Wholesale Storage

   a. Valence - 500 tonnes

   a. Limoges - 500

   b. Villerbanne (suburb of Lyon) 400. Has barreling facilities.

   b. Saintes - 300

   b. Poitiers - 500

   c. Niort - cap. unknown

   d. Grenoble - 370. Has barreling facilities.

   e. LePuy - 500

   f. Tulle - 140

   g. Guret - 500

   h. Perigeux - 60

   i. Gap - 60

   j. Vienne - 200

   k. St. Etienne - 110

   l. Clermont - 60. Has barreling facilities.

   m. Moulins - 500

   n. Bourges - 1,000

   o. Nevers - 500

   p. Tours - probably large capacity. Has barreling facilities.

   q. Cusset - 40

   r. Argers - delivery station ?

101

3. Terminals and Refinery Storage

   a. LaPallice - bulk storage terminal 20,000. Should probably have priority above any in Group I or II. Has barreling facilities.

   b. Donges - refinery tank farm 150,000 (1/3 in finished products).

   c. Nantes - bulk storage for 45,000 tonnes.

4. Indeterminate

   a. Grandieu

   b. Mainbresson

   c. Chevagne - dump between railroad line and canal immediately west of the station between between Chevagne and Messanges.

   d. Auxois - dump exactly between Pouilly church and Chailly church.

102

SECRET SECRE

SYSTEM II.

Attack on Mediterranean Coast 1/

Priority A -- Mediterranean Coastal Area

1. Barrel Dumps

Same as System I.

2. Wholesale storage

Same as System I.

3. Terminals and refinery storage

Same as System I.

4. Indeterminate

Same as System I.

Priority B -- Intermediate belt about 75 miles deep back of the coastal area.

1. Barrel Dumps

None identified.

2. Wholesale Storage

	Capacity (in tonnes)	
a. Toulouse	4500	Has barreling facilities
b. Agen	800	
c. Villerbanne (Lyon)	400	Has barreling facilities.
d. Valence	500	
e. Grenoble	370	
f. Le Puy	500	
g. Montelimar	70	
h. Vienne	200	
i. Mendes	100	

1/ * Indicates detailed information has already been listed under System I.

103

SECRET

J. Gap	60	
k. Albi	100	
l. Villeneuve	100	
m. St.Etienne	110	
n. Tarbes	60	
o. Auch*		

3. Terminals and Refinery Storage

None

4. Indeterminate

a. Grandrieu

a. Mainbresson 185 tonnes

b. Castelsarrasin

Priority C -- Remainder of Southern France (approx..South of Loire-Lyon line)

1. Barrel Dumps

a. St. Etienne*

b. Chatelerrault* 100 piles of fifty 200 litre petrol containers.

2. Wholesale Storage Capacity (in tonnes)

a. Begles	8,750	Has barreling facilities
b. Bayonne	5,000	Has barreling facilities.
c. Floirac	2,400	Has barreling facilities
d. Limoges	500	Has barreling facilities
e. Guret	500	
f. Saintes	300	

SECRET

g. Bourges	1,000	Has barreling facilities
h. Tours	Probable large capacity.	Has barreling facilities.
i. Moulins	500	
j. Tulle	140	
k. Nevers	500	
l. Poitiers	500	
m. Clermont	60	Has barreling facilities
n. Perigeux	60	
o. Cusset	40	
p. Pau	30	
q. Dax	30	
r. Ohlette *		
r. Angers		

3. Terminal and Refinery Storage

		Capacity(in tonnes)	
a. Pauillac	Refinery tank farm (for finished product)	197,000	(1/3
b. Bordeaux	Bulk storage terminals:	32,500 6,175 3,500 12,700 14,800 3,500	
c. Bec d'Ambes	Refinery tank farm for finished product)	129,000	(1/3
	Bulk storage & docks	17,000	
d. Furt	Bulk storage terminal	4,000	
e. LaPallice	Bulk storage terminal (Has barreling facilities)	20,000	
f. Donges	Refinery tank farm for finished product)	150,000	(1/3
g. Nantes	Bulk storage	45,000	

105

SECRET

4. Indeterminate

Ascain *

St. Vincent de Tyrosse*

Bayonne

Bordeaux

Bassens

Paludate

Chevagne*

Auxois*

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S E C R E T

System III

Attack on Southern Biscay Coast[1]

Priority A -- Coastal Area

1. Barrel Dumps

   Same as System I

2. Wholesale Storage

   Same as System I plus Saintes which is "d", making Dax "e" and Pau "f"

3. Terminal and Refinery Storage

   Same as System I plus LaPallice which should be "d" making Furt "e"

4. Indeterminate

   Same as System I

Priority B -- Intermediate belt about 75 miles deep back of the coastal area

1. Barrel Dumps

   a. Chatelerrault[1] - 100 piles of fifty 1200-litre petrol containers

2. Wholesale Storage

a.	Toulouse	4500	Has barreling facilities
b.	Agen	800	

1/ Indicates more detailed information has already been listed under System I

107
SECRET

c.	Limoges	500	Has barreling facilities
d.	Poitiers	500	
e.	Tarbes	60	
f.	Perigeux		
g.	Tulle	140	
h.	Villeneuve	100	
i.	Auch1/		
j.	Niort		
k.	Angers		
l.	Tours		

3. Terminal and Refinery Storage

   a. Donges -- Refinery tank farm 150,000
      (1/3 for finished products)

   b. Nantes -- Bulk storage for 45,000

4. Indeterminate

   Castelsarrasin

Priority C -- Remainder of Southern France (approx. south of Loire-Lyon line)

1. Barrel Dumps - **None identified**

2. Wholesale Storage

a.	Bourges	1,000	Has barreling facilities
b.	Guret	500	
c.	Carcassonne1/	610	
d.	Moulins	500	
d.	Nevers	500	

1/ Indicates more detailed information has already been listed under System I

108
SECRET

SECRET

e.	Albi	100	
f.	Narbonne	500	
f.	Perpignan	500	
g.	Marseilles	1900	
g.	Valence	500	
g.	LePuy	500	
g.	Villerbanne	400	
h.	Avignon1/	380	
i.	Beziers	60	
i.	Nimes	120	
i.	Mendes	100	
i.	St. Etienne	110	
i.	Vienne	200	
i.	Clermont	56	Has barreling facilities
j.	Toulon	750	
k.	Digne	500	
k.	Grenoble	370	Has barreling facilities
l.	Montelimar	70	
m.	Antibes	3200	Has barreling facilities
n.	Nice	1000	tonnes minimum, probably more
o.	Cusset	40	
p.	Brignoles	60	

1/ Indicates more detailed information has already been listed under System I

109
SECRET

q. Gap 60

3. Terminal and Refinery Storage

a. Marseilles 23,000; 44,000; 6,250; 6,500

b. L'Avera -- Refinery tank farm 200,000 (1/3 for finished products)

c. Port St. Louis du Rhone 36,000; 22,000; 9,000

d. Etang de Berres -- Refinery tank farm 190,000 (1/3 for finished products)

e. Martigues -- Refinery tank farm 152,000 (1/3 for finished products)

Bulk storage terminal 6,500

f. Sete (Balaruc) 40,000

g. Frontignan -- Refinery tank farm 90,000 (1/3 for finished products)

4. Indeterminate

a. Aubagne

a. Cassis

b. Orange

c. Grandieu

c. Mainbresson

d. Chevagne 1/

e. Auxois 1/

f. Istres -- See description System I, Priority A, number "c"

1/ Indicates more detailed information has already been listed under System I

Due to its large size, the following document has been filmed in segments. The order of the segments is as follows: left to right, top to bottom.

System I

PROVISIONAL EDITION

SECRET

SOUTHERN FRANCE: PETROLEUM FACILITIES

JUNE 1943

A) Letters indicate location priority for this system. Text gives
B) internal priorities within each
C) location priority area.

BAY OF BISCAY

SPAIN AND

ANDORRA

SWITZERLAND

ITALY

MEDITERRANEAN SEA

Donges 50,000

Nantes 45,000

Angers (100?)

Tours (100?)

Auxois

Bourges 1,000 B

Nevers 500

Châtellerault 740

500 Poitiers

Chevagnes

Moulins 500

LAKE GENEVA

Niort (100?)

20,000 B La Pallice

Guéret 500

Cusset 40

Saintes 300

Limoges 500 B

60 B Clermont

Villerbanne 400 B

Vienne 200

110 St. Étienne

Tulle 140

Périgueux 60

24,000 Furt

4,000 Bec d'Ambes

43,000 47,000 BORDEAUX 73,000

Bassens Floirac 1,000 B

3,250 B Bègles

Le Puy 500

370 B Grenoble

Valence 500

Grandrieu

100 Mende

Montélimar 70

Gap 60

100 Villeneuve

Agen 800

Castelsarrasin

Orange

Digne 500

Avignon 320 B

Albi 100

Nîmes 120

Nice 1,000

Antibes 3,200 B

Dax 30

St. Vincent de Tyrosse

(100?) Auch

Toulouse 4,500 B

30,000 Frontignan Sète 40,000

Port St. Louis du Rhône

Brignoles 60

5,000 B Bayonne

Ohlette Ascain

100? St. Étienne

St. Jean

Pau 30

Tarbes 60

610 Carcassonne

Bézieres 60

500 Narbonne

MARSEILLE 1,900

Aubagne

Cassis

Toulon 750

Perpignan 500

Istres Étang de Berres 24,000

31,000 47,000 L'Avera

Martigues 6,500

Refinery Storage

Bulk Storage Terminal

Wholesale Storage Facility

Indeterminate type of Facility

Barrel Dump

1,000 Indicates size of Facility in tons

B Barreling Facility

Railroad

0 25 50 75 MILES

0 25 50 75 KILOMETERS

Reliability Code: 2B–1B–2

MAP NO. 2446
3 JULY 1943

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64

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Section 5

Line: Chartres-Samur-Niort-Saintes

Target Section: Niort to St. Jean d'Angely (49 kms.)

This line, of fairly high capacity, runs parallel to the main Paris-Hendage line only 50 to 75 kms. further west. It provides an adequate substitute as far as Bordeaux. It is a double-track steam railroad It has a maximum permissible axle load of 16 tons and the maximum grade is 1.5 per cent.

The stretch to be attacked is 49 kms. long and includes five bridges as follows: (There is an aerial photograph of the marshalling yards and other railroad facilities at Niort. This is appendix 90 to the British handbook).

Distance from Niort in (Kms.)	Location of Bridges
0 - 6	Bridge over R. Guirande.
49	Bridge over R. Boutonne.
	Bridge over R. Nie.
	Bridge over the St. Jean d'argely-Taillebourg line.
11 -16	Bridge over a stream.

Section 6

Line: Poitiers-Niort-La Rochelle

Target Section: Niort to junction SE of La Rochelle at Aigre-Feuille (50 kms.)

The strategic importance of this line is the same as the Chartres-Saintes line which it joins

at Niort. It is a high capacity arm of the main north-south lines which it connects to the important parts of La Rochelle and Rochefort. It is a double-track, steam railroad. Maximum permissible axle load is 16 tons and the maximum grade less than 1 per cent.

The section to be cut, 50 kms. in length, has been chosen in order to eliminate access to both La Rochelle and Rochefort. Lines to these towns meet at Aigre-Feuille. There are eight bridges on this stretch, as follows:

Distance from Niort in (kms.)	Location of bridges
6 - 10	Bridge over R. Guirande[1/]
14 - 19	Two bridges over arms of a river.
19 - 22	Two bridges over arms of a river.
25 - 30	Three bridges over streams.

1/ Located southwest of the St. Symphorien Station.

Section 7

Line: Nantes - Orleans - LaRochelle - Bordeaux

Target Section: Velluire to LaRochelle (41 Kms)

This double track steam railroad is important in that it provides high capacity rail communication from the north parallel to and substitutable for the other arteries entering the Southern Biscay coastal area at LaRochelle, Rochefort, Saintes and Angouleme. It permits a maximum axle load of 16 tons. It has a grade of one percent at the maximum.

The target recommended covers the 41 km section from Velluire, where several lines converge, to LaRochelle. There is an aerial photograph of LaRochelle in Appendix 89 to the British Handbook. The target section includes about 25 bridges, all but one of which are over canals. Since this is low lying marshy country, these canals can be presumed to be mostly drainage canals. The location of the bridges follows:

Distance from Velluire (in Kms)	Location of Bridge
12-18	Bridge over the R. Sevre.
4-12	Four bridges over canals.
12-18	Bridge over a canal.
18-26	Four bridges over canals.
0-4	Two bridges over small canals.
12-18	Three bridges over small canals.
18-26	Eight bridges over small canals.
37-41	Bridges over several small canals.

SECRET

Section 5

Line: Paris-Bordeaux

Target Section: Libourne to Bordeaux - 41 km.

This is one of the most heavily traveled lines in southern France and would be the main route for rushing reinforcements to the Bay of Biscay and the Gironde Estuary. It is electrified for its entire length and is well disposed for a heavy movement of traffic.

The section chosen for attack is that from Libourne to Bordeaux. This is double track and has virtually no grades. The maximum permissible axle load is 16 tons. Numerous engineering structures are present on this section of line but details are available on the construction of only a few. The following list is therefore tentative.

1. Bridges and Viaducts

   Libourne Viaduct -- 36 - 41[1/]

   Bridge over R. Dordogne -- 36 - 41

   This bridge is of masonry construction

   Bridge over R. Laucence -- 23 - 27

   Bridge over R. Ambares -- 14 - 18

   Bridge over tributary of R. Dordogne -- 27 - 32

2. Tunnels

   Unidentified tunnel -- 11 - 14

1/ Figures indicate kilometers from Bordeaux-St. Jean.

Several unidentified tunnels -- 7 - 11

3. Bridge over small tributaries of R. Dordogne -- 32 - 36

The following description of the Libourn Viaduct is available. After having crossed the R. Dordogne on leaving Libourne station the line crosses a valley 3 1/2 kms. wide which is subject to flooding. This crossing is achieved by a straight masonry viaduct prolonged at both ends by embankments. The viaduct consists of 100-10 m. span arches, elliptical in shape. The arches are built of soft stone and .70 m. thick at the keystones. They are protected by a covering layer of concrete 0.15 to 0.20 m. thick. There is first a layer of mortar 0.02 m. thick, then a layer of concrete 0.12 to 0.15 m. thick, and then a layer of Puzzolane mortar 0.02 m. thick. The piers, 1.70 m. thick and 1.90 m. high from their original level, are built on a pile foundation, each pier resting by a framework on 44 piles. Each pile is 5.20 m. long and is driven through the strata to rest on hard gravel.

Details are available on the railroad bridge over the R. Garonne in Bordeaux. This bridge occurs south of Bordeaux-Benauge where junctions exist which would permit use of by-pass routes. This target has the further drawback of being in the city proper and being difficult to approach.

34 S
SECRET

Section 6

Line: LaRoche-sur-Yon-La-Rochelle-Bordeaux

Target Section: Cavignac to Bordeaux - 41 km.

This line serves the same areas as the Paris-Bordeaux. It is a slightly less direct route for traffic from Paris but it provides a more direct connection with the western coastal areas of northern France. The line is double track throughout. The recommended list of target priorities is as follows.

1. Viaducts and bridges

   Viaduct and bridge over R.Dordogne -- 19 - 24 km.[1]

   Bridge over stream - 35 - 41

   Bridge over stream -- 27 - 30

   Bridge over road - 15 - 19

2. Tunnels

   Approximately 1 km. long -- 7 - 15

The Dordogne bridge is 562 m. long. It consists of 8 metal girders of which the 2 at the ends have a span of 60 m. each. The height of the metal pillars is 16.7 m. The lower parts of the pillars are built of masonry. The height of the rails above water level is 21.8 m.

1/ Figures indicate kilometers from Bordeaux.

35 SECRET

The viaduct is composed of 3 sections:

a. A steel girder section on right bank is 295 m. long and consists of 6 girders of 45 m. span each, resting on 5 masonry pillars and 2 abutments.

b. A steel girder section on left bank is 599 m. long. It consists of 13 girders of 45 m. span each. This viaduct has a curve with a radius of 1500 m.

c. A central masonry section joining the two is 580 m. long and consists of 40 arches of 12 m. span each.

This line also crosses the Garonne bridge mentioned in connection with the preceding target.

36
SECRET

Section 7

Line: Grenoble-Veynes-Marseille

Target Section: Veynes to Volx - 93 kms.

The importance of this single track line is that it provides a by-pass route for the two Rhone valley lines. It also affords an alternative route for reinforcements from northern Italy to the French Mediterranean coast east of the Rhone since it connects with the Modane-Montmelian double track line.

Except for a short section of line about 10 km. long immediately south of Veynes, the section between Veynes and Volx is single track. The maximum permissible axle load is 16 tons. Some grades on this steam operated line are quite steep and the minimum radius of curves is 250 m. These factors reduce the usefulness of the route for heavy emergency traffic.

Numerous engineering structures occur along this stretch but relatively few details are available as to their size or construction. The following is a tentative priority listing of targets.

1. Bridges:

   Over R. Largue -- 0-2 1/

   Over R. Lauzon -- 2-7

   Over R. Jabron -- 36-42

   Over R. Buech -- 42-61

   Over R. Veragne -- 42-61

1/ Figures refer to kilometers from Volx.

Over R. Riou -- 64-76

Over R. Channe -- 64-76

Over R. Petit Buech -- 76-85

Over streams 2-7 (2 bridges); 12-20 (2 bridges); 20-26 (2 bridges); 26-30 (1 bridge); 30-36 (3 bridges); 36-42 (3 bridges); 42-61 (2 bridges); 61-64 (1 bridge); 64-76 (3 bridges); 85-93 (1 bridge).

2. Tunnels:

1 km. long -- 42-61

Section 8

Line: Brioude-Nimes

Target Section: Langogne to La Bastide-St. Laurent-les-Bains - 19 kms.

This line is important for two reasons: it connects with the double track line Paris-Clermont-Ferrand-Brioude and it provides a by-pass for the major Rhone valley lines.

The maximum permissible axle load on this single track line is 18 tons. The maximum grades are 1 to 2.5%. Steam traction is used.

Information on size and construction of engineering structures is lacking. Tentative target priorities are:

1. Bridges:

Over R. Allier -- 2[1]/

1/ Figures indicate kilometers from Langogne.

SECRET

Over R. Allier -- 10

Over R. Allier -- 15

Over R. Allier -- 16

Over streams -- 8, 9, 11, 14, 17

2. Tunnels:

Short tunnel -- 5

39

SECRET

Section 9

Line: St. Flour to Beziers

Target Section: St. Flour to Le Monastier--80 km.

This line provides a good by-pass route for the Rhone valley lines and for the Paris-Brive-Toulouse line. In addition it conveniently connects with the double track Paris-Clermont Ferrand-Brioude line.

It is single track over the 80 km. section recommended for attack, although it is double track for short stretches on other sections. Traction is electric. Maximum permissible axle load is 18 tons. Grades are slight.

The following list of targets is subject to revision on the basis of additional information regarding construction and size.

1. Bridges and Viaducts:

Garabit Viaduct over Truyere Gorge -- 14[1/]

Viaduct over R. Crueize -- 55 - 72[2/]

of masonry construction, 215 ft. high.

1/ Figures indicate kilometers from St. Flour.

2/ The total length of this viaduct is 565 m. The height of rail above the river is 122 m. The viaduct consists of 5 spans of 55.5 m. each, a parabolic arch of 165 m., and 2 end spans of 51.8 m. At both ends of the metal viaducts are small masonry arches. The parabolic arch supports a horizontal trellis girder 5.16 m. high. The metal girders rest on metal pillars. The neighboring pillars of the arch have 6 stories and their metallic part is 63.67 m. high. Their section is 5 x 7 m. at the base end and 5 x 2.33 m. at the summit.

SECRET

Bridge over R. Rimeize -- 37 - 48

Bridge over R. Malagazane -- 37 - 48

Bridge over R. Chapouillet -- 29 - 37

Bridge over R. Mongon -- 0 - 11

Bridge over tributary of R. Colagne -- 55 - 72

Bridge over tributary of R. Colagne -- 55 - 72

Bridge over tributary of R. Travel -- 55 - 72

Over unidentified bridges -- 48 - 55 (2 bridges) 37 - 48, 0 - 11 (4 bridges)

Over a small river -- 55 - 72

2. Tunnels:

Long tunnel -- 55 - 72

Tunnel -- 55 - 72

Tunnel -- 55 - 72

Tunnel -- 48 - 55

Section 10

Line: Bourges-Toulouse

Target Section: Viescamp to Figeac--51 km.

The only significance of this single track line is that it provides a convenient by-pass route for the main double track line Paris-Brive-Toulouse.

Steam traction is used. Maximum permissible axle load is 16 tons. Little information is available on construction and size of the engineering structures on this line. The following priority list of targets

41

is subject to revision on the basis of additional information.

1. Bridges:

Over R. Lot -- 51[1/]

This bridge is of iron girder construction and rests on 2 pillars.

Over R. Cere -- 2 - 11

Over R. Rance -- 19 - 31

Over R. Cele -- 31 - 37

Over R. Cele -- 31 - 37

Over R. Cele -- 37 - 44

Over R. Cele -- 37 - 44

Over R. Cele -- 37 - 44

Over R. Cele -- 37 - 44

Over R. Cele -- 44 - 51

Tributary over R. Cere -- 2 - 11

Over tributaries of R. Cele -- 31 - 37;

37 - 44 (3 bridges); 44 - 41 (3 bridges)

Over unidentified rivers 2 - 11; 11 - 19

(6 bridges); 19 - 31 (8 bridges);

31 - 37 (5 bridges)

2. Tunnels:

Tunnel -- 37 - 44

3 tunnels -- 51

1/ Figures indicate kilometers from Viescamp.

Section 11

Line: Brive - Figeac

Target Section: St. Denis-pres-Martel to Figeac -- 65 km.

This is a by-pass route for the double track Paris-Brive-Toulouse line. It has no additional significance. It is single track and steam operated.

There are bridges and tunnels on this section of line, but beyond the fact that one bridge is located just south of St. Denis-pres-Martel (immediately north of Montvolent) no information is available on the specific location of engineering works.

Section 12.

Line: Perigueux-Tarbes

Target Section: Monsempron-Libos to Siorac -- 44 km.

This double track line provides a convient by-pass of substantial capacity for the Paris-Brive-Toulouse and Paris-Les Aubrais-Bordeaux lines. Gradients are slight. Maximum permissible axle load is 16 tons. Steam operation prevails.

Numerous engineering structures exist on the line but no information is available as to their size or construction. Tentative target priorities are:

1. Bridges:

   Over R. Attemance -- 4-11 1/ (3 bridges)

   Over R. Attemance -- 11-14

1/ Figures indicate kilometers from Monsempron-Libos.

SECRET

Over R. Attemance --14-20 (3 bridges)

Over R. Attemance -- 20-27 (4 bridges)

Over arm of R. Attemance -- 14-20

Over tributaries of R. Attemance -- o-4 (2 bridges); 4-11; 11-14; 14-20 (3 bridges); 20-27 (2 bridges)

Over unidentified river -- 38-44 (2 bridges)

2. Tunnels:

Long tunnel -- 27-38

Section 13

Line: Bergerac-Falgueyrat

Target Section: Bergerac to Falgueyrat -- 35 km.

This steam operated, single track line provides a by-pass route for the Paris-Les Aubrais-Bordeaux and Paris-Brive-Toulouse double track lines. Engineering structures exist on the section of line recommended for operations but no information is available beyond the fact that there is a bridge several miles south of Bergerac.

Section 14

Line: St. Mariens-Blaye

Target Section: St. Mariens-Blaye -- 20 km.

This line is single track and steam operated. It provides a by-pass route for the La Roche-sur-Yon-La Rochelle-Bordeaux line and serves Blaye, a port on the

SECRET

Gironde Estuary. If operations on the Cavignac to Bordeaux section of the LaRoche-sur-Yon-La Rochelle-Bordeaux line take place less than 27 miles north of Bordeaux, at which point a by-pass route joins the Cavignac-Bordeaux line, no action need be taken on this St. Mariens-Blaye route. In such an event Blaye will nevertheless be effectively served with rail traffic and if interruption of traffic to Blaye is deemed necessary, the St. Mariens-Blaye line should be attacked.

No information is available regarding engineering structures on this line.

SECRET

SYSTEM II

(Ten Targets)

Detailed Analysis

Section 1

Line: Bayonne-Toulouse-Sete

Target Section: Toulouse to Bram. (71 km.)

This double track electrified line has the highest capacity of any line in Southern France. It provides the chief connection between Southeastern and Southwestern France. Troops and supplies would travel over this line from present concentrations in the center of the Southern area from the Biscay coast and from the northwest to reach the Mediterranean region.

The section of the line chosen for special operations lies between Toulouse and Bram, a distance of 71 km. Maximum permissible axle load is 16 to 20 tons. The gradient is moderate at its maximum: one half of one per cent. There are no data available as to curves. The engineering works include 30 bridges. On the western end of the stretch there are 12 bridges within 30 km. of Toulouse all of which cross the river Hers and its tributaries.

The following list indicates the location of engineering works recommended for target operations. No attempt has been made to indicate priority, in view of the lack of details of structure.

SECRET

Distance from Toulouse (in kilometers)	
0-13	4 Bridges over River Hers, between Toulouse and Escalquens.
57-65	Bridge over River Treboul between Castelnaudary and Pexiora.
65-73	Bridge over River Priouille between Pexiora and Bram.
13-19	3 Bridges over tributaries of the River Hers between Escalquens and Montalour.
19-23	Bridge over tributary of the River Hers between Montalour and Baziege.
23-27	Two bridges over tributaries of the River Hers between Baziege and Ville Nouvelle.
27-33	Two bridges over tributaries of the River Hers between Ville Nouvelle and Ville France.
40-46	Between Avignonet and Segala, bridge over Canal du Midi.
57-65	Between Castelnaudary and Pexiora, bridge over tributary of the Treboul.
27-33	Bridge over small river.
33-40	Four bridges over small rivers.
40-46	Four bridges over small rivers.
46-51	Bridge over a river.
51-57	Three bridges over rivers.
57-65	Bridge over a river.
65-73	Bridge over a river.

Section 2

Line: Marseilles to Genoa

Target Section: Nice to Cannes la Bocca (32 km.)

This is the most direct of three lines connecting Italy with the French Mediterranean Coast. In the event of an invasion of the latter prior to a United Nations occupation of Northern Italy, German and Italian forces would undoubtedly make heavy use of this route. Insofar as Italian troops may be expected to oppose an invasion of Southern France, the line is of particular importance.

The two coastal lines merge at Nice and from Nice to Cannes-la-Bocca no standard gauge by-passes are available. The section of line which has been selected for attack therefore is between Nice and Cannes-la-Bocca.

This section of line is double track and steam operated. The maximum permissible axle load is 18 tons. Maximum grades are 1/2 to 1 percent.

While some information is available on the engineering structures along this section of line, no details are at hand as to the length or height of these structures. The following schedule of target priorities is therefore tentative:

1. Bridges:

   Over River Brague -- 13 1/

   Over River Loup - 18

   Over River Valvan - 20

   Over River Cagnes - 20

1/ Figures indicate kilometers from Cannes.

SECRET

Over River Vaux - 21

Over River Magnan - 28

Over Arms of River Var - 23

Bridges over Streams 6, 12, 17, 22, 26

2. Tunnel

Approximately 1 kilometer long. Branches into two double track tunnels where the lines to Vintimille and Breil separate, the former continuing along the coast and the latter running northeast.

Section 3

Line: Paris-Lyon-Marseille (East Rhone)

Target Section: Livron to Orange(78 kilometers)

Two double track lines follow the Rhone Valley to the French Mediterranean coast. These lines provide the most direct routes to this coast for reinforcements from northeastern France and Germany and a major alternate route for reinforcements from Northern Italy. One of the lines is discussed in this section, the other is discussed in Section 4, following.

Available information, which is meager, indicates that the main portion of the German mass of manoeuver is located in Northern France and Germany. The Italian mass of manoeuver is thought to be in Italy. It is highly important, therefore, that traffic along these main Rhone valley railroads be interrupted.

The Livron to Orange section is double track over its entire 78 kilometer length. Grades do not exceed .5 to 1 percent. The maximum permissible axle load is 18 tons. Steam traction is used.

There seem to be many engineering works along this section of line, but few details are available as to type of construction employed, lengths of bridges and so forth. Such data are needed to supplement the following tentative selection of points for attack.

Bridges:

Over River Mousillon -- 10 1/

Over River Tessone - 11

Over River Roubion - 28

Over River Reaille - 34

Over River Berre - 45

Over River Lauxon - 59

Over River Lez - 63

Over River Eygues - 77

Over tributaries of RiverRhone - 12-27 (15 bridges)

Over streams, 1, 2, 3, 4, 5, 8, 9, 32, 39, 40, 42, 46, 58, 63, 67, 73, 78

Section 4

Line: Paris-Lyon-Marseille (West Rhone)

Target Section: La Voulte Rhone to Le Teil(40 kilometers)

This is the other of the two Rhone valley lines which will carry the main traffic of reinforcements from Northeastern France and Germany and a major portion of the traffic from Italy to the French Mediterranean coast. The significance of these lines was discussed in Section 3, immediately preceding.

1/ Figures indicate kilometers from Livron.

 SECRET

The section of line from La Voulte-Rhone to Le Teil is double track for its entire length of 30 kilometers. Steam traction is used. Maximum grade is 1/2 percent. Maximum permissible axle load is 16 tons.

No details are at hand as to the size or construction of the engineering structures along the line. Tentative target priorities are as follows:

1. Bridges:

   Over River Oubeze - 0 - 6 1/

   Over River Payre - 6 - 11

   Over River Lavexon - 24 - 27

   Over streams

   5 bridges between 0 - 6

   4 bridges between 6 - 11

   7 bridges between 11 - 18

   4 bridges between 18 - 23

   1 bridge between 24 - 27

   3 bridges between 27 - 30

2. Tunnels

   Short tunnel - 11 - 18

1/ Figures indicate kilometers from La Voulte-Rhone.

SECRET

Section 5

Line: Beziers-St. Flour

Target Section: Severac le Chateau to Tournemire-Roquefort (55 km.)

This line is electrified the entire distance from Beziers to St. Flour and several kilometers beyond to Neussargues . At these two points it joins second class steam lines running north about 30 km. to connect with the double track line to Clermont-Ferrand.

It is single track all the way with the exception of two sections -- the 10 km. stretch between Faugères and Badérieux and the 44 km. stretch between Millau and Campagnac. The maximum permissible axle load is 18 tons. No details are available concerning curves. This line constitutes a fairly adequate by-pass to the main north-south lines, Paris-Lyon-Marseille and Paris-Brive-Toulouse.

The section to be attacked covers a distance of 55 kms. The gradient of this road is steep, with a maximum of over 2%. It follows the Sernon Valley and then runs close to the river Tarn, crossing it or its tributaries 6 times in a stretch of 9 km. In all, there are 18 bridges and 6 tunnels in this stretch of railroad. There follows a list of bridges and tunnels on this line.

SECRET

1. Bridges

Distance from Tournemire Roquefort (in kilometers)	Location of Bridge
0-7	Bridge over River Cernon between Tournemire-Roquefort and St. Rone-de-Cernon.
7-14	Bridge over River Cernon between St. Rone-de-Cernon and St. Georges-de-Lusencon.
14-25	Bridge over River Tarn between St. Georges-de-Lusencon and Millau.
31-36	Bridge over River Lemensonesque, between Aguessac and La Cresse Riviere.
7-14	Three bridges over tributaries of R. Cernon.
14-25	Bridge over tributary of R. Cernon. Two bridges over tributaries of the River Tarn.
25-31	Three bridges over tributaries of the River Tarn.
36-46	Bridges over a tributary of the River Lemensonesque.
46-55	Four bridges over tributaries of River Arveyron.

2. Tunnels

Distance from Tournemire Roquefort (in kilometers)	Location of Tunnels
36-46	Four tunnels between La Cresse Riviere and Engayresques.
46-55	Two tunnels between Engayresques and Severac le Chateau.

Section 6

Line: Paris-Clermont Ferrand-Brioude-Nimes-Tarascon
Target Section: La Bastide-St. Laurient-les-Bains to Ales (68 kms.).

This line provides a low capacity by-pass for the southern end of the Paris-Lyon-Marseille line as well as for the Paris-Brive-Toulouse line farther west. In this respect, it is a substitute by-pass to the Beziers-St. Flour electrified line.

It is a single track steam line between Brioude and Ales (185 kms.) and double track throughout the rest. The maximum permissible axle load is 18 tons. The gradient is steep at the maximum - between one and two and one-half percent. There are no details available as to curves.

The stretch recommended for target operations is 68 km. in length and has 19 bridges and 28 tunnels. The location of these installations follows:

1. Bridges:

Distance from La Bastide (in kilometers)	Location and number of Bridges
0 - 10	Bridge over the River Allier between La Bastide and Prevencheres
10 - 21	Two bridges over the River Chassezac between Prevencheres and Villefort
30 - 37	Two bridges over rivers between Genolhac and Chamborigoud

Distance from La Bastide (in kilometers)	Location and number of Bridges
10 - 21	Bridge over stream.
21 - 27	Two bridges over streams.
27 - 30	Four bridges over streams.
37 - 42	Bridge over a stream.
50 - 55	Two bridges over streams.
55 - 61	Three bridges over streams.
61 - 67	Bridge over a stream.

2. Tunnels

Distance from La Bastide (in kilometers)	Location and Number of Tunnels
37 - 42	A long tunnel 1 1/2 kms. in length, two kms. south of Chamborigaud.
10 - 21	Between Prevencheres and Villefort one tunnel 1 km. in length and one 600 m. in length.
0 - 10	8 tunnels.
21 - 27	4 tunnels.
10 - 21	6 short tunnels.
27 - 30	3 short tunnels.
30 - 37	2 short tunnels.
42 - 47	A short tunnel.
47 - 59	A short tunnel.

Section 7

Line: Grenoble-Veynes-Marseille

Target Section: Veynes to Volx -- 93 kms.

The importance of this single track line is that

it provides a by-pass route for the two Rhone valley lines. It also affords an alternative route for reinforcements from northern Italy to the French Mediterranean coast east of the Rhone, since it connects with the Modane-Montmelian double track line.

Except for a short section of line about 10 m. long immediately south of Veynes, the section between Veynes and Volx is single track. The maximum permissible axle load is 16 tons. Some grades on this steam-operated line are quite steep and the minimum radius of curves is 250 m. These factors reduce the usefulness of the route for heavy emergency traffic.

Numerous engineering structures occur along this stretch, but relatively few details are available as to their size or construction. The following is a tentative priority listing of targets.

1. Bridges:

   Over River Largue -- 0 - 2[1]

   Over River Lauzon -- 2 - 7

   Over River Jabron -- 36 - 42

   Over River Buech -- 42 - 61

   Over River Veragne -- 42 - 61

   Over River Riou -- 64 - 76

   Over River Channe -- 64 - 76

   Over River Petit Buech -- 76 - 85

1. Figures refer to kilometers from Volx.

SECRET

Over streams 2 - 7 (2 bridges); 12-20 (2 bridges); 20-26 (2 bridges); 26-30 (1 bridge); 30-36 (3 bridges); 36-42 (3 bridges); 42-61 (2 bridges); 61-64 (1 bridge); 64-76 (3 bridges); 85-93 (1 bridge).

3. Tunnels:

1 km. long -- 42 - 61

Section 8

Line: Rone-Castres

Target Section: St. Juery to Castres (50 kms.)

There are no available data on engineering installations on this single track steam operated line The line provides a by-pass for the St. Suplice-du-tarn -- Castres line to the south. (See below), and for the north - south main line Paris-Brive-Toulouse. There is evidence of a bridge at Albi over a river.

Section 9

Line: Montauban to Bedarieux

Target Section: St. Suplice du Tarne to Junction west of Castres (approximately 40 kms.)

As noted above, this line provides a by-pass to the east-west main line, Toulouse - Narbonne, as well as a by-pass to the north-south main line, Paris-Brive-Toulouse.

There are few data regarding the engineering structures on the section selected; but evidence exists that there are bridges, 5 of which are on the 20 km. stretch between St. Suplice and Lavaur.

58

SECRET

SECRET

Section 10

Line: Pamiers to Belvèze-Aude.

Target Section: Pamiers to Belvèze-Aude (approx. 50 kms.)

This line provides an east west by-pass for the main Toulouse-Narbonne line. It is a single track steam railroad joining at Pamier with the single track electrified line from Toulouse to Foix. Were it left intact the value of attacking the Toulouse-Narbonne line would be reduced. No information has been found regarding engineering structures on this line between Pamiers and Caudeval (35 kms.). However there is evidence of 2 bridges over rivers between Caudeval and Escueilleur (7 kms.) and 2 bridges over rivers, between Escueilleur to Belvèze-Aude, (8 km.).

SECRET

System III

(Twelve Targets)

Section 1

Line: Bayonne-Tarbes-Toulouse

Target Section: Tarbes to Orthez - 105 kms.

This is the most important and highest capacity line in the extreme southern part of France. It connects the southern Biscay coast to the Western Mediterranean coast; and it also provides outlets to either coast for traffic coming from the North by means of the heavily-traveled Paris-Brive-Toulouse line. At Tarbes it joins with a secondary north-south line. It is a double track, electrified line. Maximum permissible axle load is 16 to 18 tons.

The stretch to be attacked is 105 kms. in length and has 25 bridges. There is no detailed information as to the length, height or structural characteristics of these bridges, listed below:

Distance from Orthez (in kms)	
25-33	Bridge over the R. Ousse-du-Dois
40-47	Bridge over the R. Ousse
47	Bridge over the R. Lagoin
82-89	Bridge over the R. Geune
95-105	Bridge over the R. Agout-Andrest
0-8	Five bridges over tributaries of the

SECRET

	R. Cave de Pou
8-14	Bridge over a tributary of the R. Gave de Pou
14-20	Bridge over the R. Gave de Pou
20-25	Two bridges over tributaries of the R. Gave de Pou
25-30	Bridge over a tributary of the R. Gave de Pou
33-40	Bridge over a tributary of the R. Gave de Pou
25-33	Bridge over a river
8-14	Two bridges over small rivers
20-25	Two bridges over small rivers
59-64	Two bridges over small rivers
64-68	Bridge over a small river
68-79	Bridge over a small river

Section 2

Line: Paris-Hendaye

Target Section: Parcoul-Medillac to Coutras - 26 kms.

This is the most important and highest capacity rail artery connecting the southern Biscay coast with areas to the North. In the light of the probable disposition of German troops and materiel the importance of this line and its by-passes is enhanced. It is a double track, electrified line. Maximum permissible axle load is 16 tons. The maximum grade is one-half of one percent.

61
SECRET

The stretch to be attacked is short, but strategic with regard to eliminating, with a minimum of operations, this route and its substitutes. There are six bridges on the section recommended for attack. Data as to the length, height and structural characteristics of these bridges are lacking. Their location follows:

Distance from Medillac (in kms.)	
0-9	Two bridges over the R. Tude
9-16	Bridge over the R. Dronne
	Bridge over the R. Chature
0-9	Two bridges over tributaries of the R. Dronne

62
SECRET

Section 3

Line: Toulouse-Bordeaux

Target Section: Tonneins to Marmande (17 kms.)

This double track steam line is a major artery connecting Bordeaux and the central Biscay coast with Toulouse and the Mediterranean. At Montauban it forms a junction with the main Paris-Brive-Toulouse line, and therefore it is a high capacity substitute for the Paris-Hendage railroad. The gradient at its maximum is 1 per cent. The line follows the Garonne Valley, and over the course of these 17 kms, it crosses three bridges. There is no information as to the length, height, or structural characteristics of these bridges, the location of which follows:

Distance from Tonneins (in kms.)	Location of Bridges
7 -17	Bridge over the R. Treo. Bridge over a tributary of the R. Garonne.
0 - 7	Bridge over a tributary of the R. Garonne.

Section 4

Line: Saintes - Beillant - Angouleme

Target Section: Angouleme to Chateaunneuf-sur-Charente (23 kms.)

This double track steam railroad is an important connecting link. At Angouleme it joins the main Paris-Hendage line (see Section 2), and at Saintes, 73 kms. west of Angouleme, with a parallel high capacity line from Chartres to Saintes (see Section 5). This connecting link between the main north-south lines is an obvious target. The permissible axle load is 16 tons and the miximum grade is one per cent.

The section chosen for target operations is limited on the west by a low capacity by-pass to the Saintes-Bordeaux line. This by-pass is cut off by attacking the designated target section. There are five bridges and one fairly long tunnel on this line, as follows:

1. Bridges

Distance from Chateauneuf-sur-Charente (in kms.)	Location of Bridges
8 - 12	Bridge over the Boeme.
20 - 23	Bridge over the R. Arguienne.
0 - 4	Bridges over tributary of the R. Charente.
8 - 12	Two bridges over tributaries of the R. Charente.

2. Tunnels

20 - 23	Tunnel, 740 m. in length.

SECRET

Line	Section and Length of Line To Be Attacked	Number of Tracks and Kind of Drive[1]	Relative Capacity on a Scale of 100
1. Genoa-Vintimille-Menton-Marseille	Cannes-la Bocca to Nice - 32 kms.	DTS	10
2. Paris-Lyon-Marseille	Livron to Orange 78 kms.	DTS	10
3. Paris-Lyon-Marseille	La Voulte-Rhone to Le Teil - 40 kms.	DTS	10
4. Paris-Brive-Toulouse	Gourdon to Cahors 41 kms.	DTS	10
5. Paris-Bordeaux	Libourne to Bordeaux 41 kms.	DTE	13
6. LaRoche-sur-Yon-LaRochelle-Bordeaux	Cavignac to Bordeaux 41 kms.	DTS	10
7. Perigueux-Tarbes	Monsenpron-Libos to Siorac - 44 kms.	DTS	8
8. St. Flour-Beziers	St. Flour to Le Monastier - 80 kms.	STE	5
9. Grenoble-Veynes-Marseille	Veynes to Volx 93 kms.	STS	4
10. Brioude-Nimes	Langogne to LaBastide 19 kms.	STS	4
11. Bourges-Toulouse	Veiscamp to Figeac 51 kms.	STS	4
12. Brive-Figeac	St. Denis-pres-Martel to Figeac - 65 kms.	STS	4
13. Bergerac-Falgueyrat	Bergerac to Falgueyrat 35 kms.	STS	4
14. St. Mariens-Blaye	St. Mariens to Blaye 20 kms.	STS	4
			100

1. DT - Double track
   ST - Single track
   E - Electrified
   S - Steam operated

It will be observed that of the 14 lines, 6 are double track throughout their entire length. The other eight are either single track or double track for such short sections that their capacity must be considered to be governed by single track capabilities.

From the point of view of prospective simultaneous invasion of both the Atlantic and Mediterranean coasts it is difficult to assign priorities among these lines on any basis other than capacity. If the coasts are felt to be of equal importance, then it will be found that the most direct routes are also those with the greatest ability to carry traffic. Accordingly, no attempt has been made in the selection of this system to establish priorities within this group of targets, on the basis of directness of route. It may be found desirable when formulating plans in the field to assign such priorities on the basis of the latest information as to the location of enemy reserve forces.

Selection of this system has been made on the basis of minimizing the number of targets found within 75 miles of the coast. It has been necessary to include in this estimate, three lines leading to Bordeaux from the east and north which are within a few miles of the Gironde Estuary and to include the coastal railroad from Genoa to Marseille. If it

is believed impracticable to cut the Bordeaux lines, the value of the system will be very much reduced since the network further north is so widespread as to afford numerous alternative routes and at least 170 trains per day, or about enough for two divisions could be run through the opening in the blockade.

Failure to interrupt the Riviera line would be less serious since the loophole would amount to only about 75 trains per day and as far as German forces are concerned, these would have to traverse the Alps twice.

SECRET

SECRET 18

SYSTEM II

(10 Targets)

ISOLATING THE MEDITERRANEAN COASTAL REGION FROM THE REST OF FRANCE AND FROM ITALY

Strategic Significance - This system is designed to aid an invasion of the French Mediterranean coast on the assumption that no simultaneous move is made against the Biscay coast. Successful attack on it would isolate a belt 50 to 75 miles deep along the Mediterranean coast. Traffic from centers containing main supply dumps and enemy reserve would thus be cut off.

General Description - This system consists of 10 target sections of railroad line. Of these 10 lines, 4 are double track, 5 are single track, and one is part double and part single. All but 2 are steam railroads.

Five of the sections recommended for attack are major rail connections providing high capacity rail transport and constituting convenient bypasses for each other. The other 5 lines have lower capacity but provide a considerable measure of substitutability for the major lines. For full effectiveness, the plan should encompass the cutting of all 10 rail lines.

The following table indicates the sections suggested for special operations:

	Line	Section and Length of Line to be Attacked	Number of Tracks; Kind of Drive[1]	Relative Capacity on a Scale of 100
1.	Toulouse-Sete	Toulouse to Bram 71 kms.	DT-E	21
2.	Paris-Lyon-Marseille	Livron to Orange ---kms.	DT-S	15
3.	Paris-Lyon-Marseille	La Voulte Rhone to Le Teil - kms.	DT-S	15
4.	Genoa-Vintimille-Menton-Marseille	Cannes-la-Bocca to Nice - kms.	DT-S	15
5.	Beziers-St. Flour	Severac-LeChateau to Tournemire (ST-E) Roquefort - 55 kms. (DT-E)		8
6.	Brioude Nimes	La Bastide-St.Laurent les Beims to Ales 68 kms.	ST-S	6
7.	Grenoble-Veynes-Marseille	Veynes to Volx kms.	ST-S	5
8.	Rone-Castres	St. Juery to Castres approx. 50 kms.	ST-S	5
9.	Monta bon to Bedarieux	St. Sulpice du Tarn to Junction West of Castres - approx. 40 kms.	ST-S	5
10.	Pamiers to Belveze-Ande	Pamiers to Belveze-Aude - approx. 50 kms.	ST-S	5
				100

1. DT - Double track; ST - Single track.
S - Steam; E - Electric.

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From the point of view of location of main German and Italian reserves, both the Rhone Valley lines and the coastal Riviera line afford the most direct routes to the French Mediterranean coastal area. But the Toulouse-Narbonne electrified line has substantially greater capacity than any of these and its degree of roundaboutness is not great enough to warrant placing it below them in priority. Current information on enemy dispositions indicates that in case of invasion of the Mediterranean coast, troops would be likely to move immediately over this line from central and southwest France.

The electrified Beziers-St. Flour line is by far the most important of the single track lines, because of its higher capacity and its central route which can serve both the eastern and western sections of the coast. The Brioude-Nimes line has perhaps some independent significance as a route from the north. There is not much to choose among the other three single track lines, which are important for our purposes only as by-passes.

SYSTEM III

(12 Targets)

ISOLATING THE SOUTHERN FRENCH BISCAY COASTAL REGION FROM THE REST OF FRANCE

Strategic Significance. This plan is designed to aid an invasion of the French Biscay coast on the assumption that there is no concurrent invasion of the Mediterranean coast. The area to be isolated has not been projected north of La Rochelle, since it was felt that the number of resulting targets would be too great for a single coordinated plan.

Successfully carried through, attack on this system will effectively isolate a region along the Biscay coast, 50 to 75 miles deep, except where it approaches the coast north of La Rochelle. Rail communication would thus be interrupted with inland points of concentration of troops and materiel.

General Description. This system consists of twelve target sections of railroad line. Of these twelve lines, seven are double track, two being electrified, and five are single track, steam operated.

The seven high-capacity lines provide alternate routes of communication between the region and the rest of France. The other five lines, of lower capacity, by providing by-passes, could serve in some measure as substitutes for the major lines. Consequently, it is

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recommended that operations be directed toward the cutting of all twelve lines with the greatest emphasis on the double track lines.

The following table indicates the sections suggested for special operations:

Line	Section and Length of Line to be Attacked	Number of Tracks; Kind of Drive [1]	Relative Capacity on a Scale of 100
1. Bayonne-Tarbes-Toulouse-[redacted]	Tarbes to Orthez 105 kms.	DT-E	15
2. Paris-Hendaye	Parcoul-Medillac to Coutras-26 kms.	DT-E	15
3. Toulouse-Bordeaux	Tonneins to Marmande 17 kms.	DT-S	11
4. Saintes-Beillant-Angouleme	Angouleme to Chateau-neuf-sur-Charente-23 kms.	DT-S	11
5. Chartres-Samur-Niort-Saintes	Niort to St. Jean d'Angely-49 kms.	DT-S	11
6. Poitiers-Niort-La Rochelle	Niort to junction SE of La Rochelle 50 kms.	DT-S	11
7. Nantes-Orleans-La Rochelle-Bordeaux	Velluire to La Rochelle - 41 kms.	DT-S	11
8. Limoges-Coutras-Brive-Coutras	Coutras to the junction near Mussidan approx. 40 kms.	ST-S	3
9. Morcenx-Tarbes	Mont-de-Marson to Riscle - 48 kms.	ST-S	3
10. Morcenx-Port Ste. Marie	Gabarret to Nerac approx. 40 kms.	ST-S	3

1. DT - Double track; ST - Single track.
S - Steam; E - Electric.

(Cont'd.)

	Line	Section and Length of Line to be Attacked	Number of Tracks; Kind of Drive	Relative Capacity on a Scale of 100
11.	Bordeaux-Falgueyrat	Eymet to Falgueyrat - approx. 20 kms.	ST-S	3
12.	Bordeaux-Libourne-Souillac	Bergerac to Libourne - approx. 70 kms.	ST-S	3

Current information as to the location of inland concentrations of German troops and materiel suggest that the Paris-Hendaye, Chartres-Niort-Samur-Saintes, Toulouse-Bordeaux, and Toulouse-Bayonne lines are the most important double-track routes between the Biscay coastal area and the rest of France. However, the Mussidan-Coutras section, although of lower capacity itself, affords connections through Perigueux to the electrified Paris-Brive-Toulouse line at Limoges and Brive, and must therefore be accorded highest priority among the single track lines.

SECRET

SYSTEM IV

(Two Targets)

ISOLATING SOUTHERN FRANCE FROM ITALY

Strategic Significance - Italian divisions have been occupying the French eastern Mediterranean coast and the Alpine border areas. If Italian troops are to be relied upon for the defense of these regions against invasion, direct rail transport to Italy will be of interest. Denial of the three western Alpine lines to the enemy would impose on him a long, round-about haul through Germany and France.

To a much smaller extent cutting of these lines would impose difficulties on transport of German troops insofar as it was desired to bring these from Austria, Southern Germany and Eastern Europe. If Italian troops were to be left out of consideration, however, it would be preferable to operate against the Rhone Valley line thus affecting traffic both from the east and from the north. For defense of the region south of Veynes, however, the system offers no advantages over System I on either hypothesis and the two should be regarded as mutually exclusive.

General Description - The most direct connection between Italy and the French Mediterranean coast is the coastal line Genoa-Nice-Marseille (it is with this line that a single track less important line connects at Nice). The other connection with Italy is less direct but nevertheless of major importance -- the line from Modane branching at Montmelion to Lyon or Valence and thence south.

The coastal line is steam operated and double track. The maximum permissible axle load is 18 tons and maximum grades are one-half to one percent.

The other line Modane-Chambery-Dijon is electrified from the Italian border to Montmelion. It is double track throughout its entire length of about 80 kilometers. The maximum permissible axle load is 18 tons and the maximum grade is three percent. (This grade occurs between Chamousset and Modane).

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OFFICE OF STRATEGIC SERVICES
Research and Analysis Branch

DETAILED ANALYSIS OF POSSIBLE VULNERABLE POINTS IN EACH TARGET SECTION

SYSTEM I

Section 1

Line: Genoa-Vintimille-Menton-Marseille

Target Section: Cannes-la-Bocca to Nice (32 kms.)

This is the most direct of three lines connecting Italy with the French Mediterranean Coast. In the event of an invasion of the latter prior to a United Nations occupation of Northern Italy, German and Italian forces would undoubtedly make heavy use of this route. Insofar as Italian troops may be expected to oppose an invasion of Southern France, the line is of particular importance.

The two coastal lines merge at Nice and from Nice to Cannes-la-Bocca no standard gauge by-passes are available. The section of line which has been selected for attack therefore is between Nice and Cannes-la-Bocca.

This section of line is double track and steam operated. The maximum permissible axle/load is 18 tons. Maximum grades are 1/2 to 1 percent.

While some information is available on the engineering structures along this section of line, no details

are at hand as to the length or height of these structures. The following schedule of target priorities is therefore tentative.

1. Bridges:

   Over River Brague -- 13[1]

   Over River Loup -- 18

   Over River Valvan -- 20

   Over River Cagnes -- 20

   Over River Vaux -- 21

   Over River Magnan -- 28

   Over arms of River Var -- 23

   Bridges over streams - 6, 12, 17, 22, 26

2. Tunnel:

   Approximately 1 km long. Branches into two double track tunnels where the lines to Vintimille and Breil separate, the former continuing along the coast and the latter running northeast.

Section 2

Line: Paris-Lyons-Marseille

Target Section: Livron to Orange - 78 km.

Two double track lines follow the Rhone Valley to the French Mediterranean coast. These lines provide the most direct routes to this coast for reinforcements

1. Figures indicate kilometers from Cannes.

SECRET

from Northeastern France and Germany and a major alternate route for reinforcements from Northern Italy. One of the lines is discussed in this section, the other is discussed in Section 3, following.

Available information, which is meager, indicates that the main portion of the German mass of manoeuver is located in Northeastern France and Germany. The Italian mass of manoeuver is thought to be in Italy. It is highly important, therefore, that traffic along these main Rhone valley railroads be interrupted.

The Livron to Orange section is double track over its entire 78 km length. Grades do not exceed .5 to 1 percent. The maximum permissible axle load is 18 tons. Steam traction is used.

There seem to be many engineering works along this section of line, but few details are available as to type of construction employed, lengths of bridges, and so forth. Such data are needed to supplement the following tentative selection of points for attack.

Bridges:

Over River Mousillom -- 10[1]

Over River Tessone -- 11

Over River Roubion -- 28

Over River Reaille -- 34

1. Figures indicate kilometers from Livron.

Bridges (cont'd.)

Over River Berre -- 45

Over River Lauxon -- 59

Over River Lez -- 63

Over River Eygues -- 77

Over tributaries of River Rhone -- 12-27 (15 bridges)

Over streams -- 1, 2, 3, 4, 5, 8, 9, 32, 39, 40, 42, 46, 58, 63, 67, 73, 78

Section 3

Line: Paris-Lyon-Marseille

Target Section: La Voulte-Rhone to Le Teil - 40 km

This is the other of the two Rhone valley lines which will carry the main traffic of reinforcements from Northeastern France and Germany and a major portion of the traffic from Italy to the French Mediterranean coast. The significance of these lines was discussed in Section 2, immediately preceding.

The section of line from La Voulte-Rhone to Le Teil is double track for its entire length of 30 kms. Steam traction is used. Maximum grade is 1/2 percent. Maximum permissible axle load is 16 tons.

No details are at hand as to the size or construction of the engineering structures along the line. Tentative target priorities are as follows:

30 SECRET

1. Bridges

Over R. Oubeze -- 0 - 6[1/]

Over R. Payre -- 6 - 11

Over R. Lavezon -- 24 - 27

Over Streams

5 bridges between 0 - 6

4 bridges between 6 - 11

7 bridges between 11 - 18

4 bridges between 18 - 23

1 bridge between 24 - 27

3 bridges between 27 - 30

2. Tunnels

Short tunnel -- 11 - 18

Section 4

Line: Paris-Brive-Toulouse

Target Section: Gourdon to Cahors - 41 km.

This line is double track and electrified except for the portion between Brive and Montauban. It is more important than any other single line in carrying troops from northeastern France and Germany to the western portion of the Mediterranean Coast, the southern portion of the Bay of Biscay Coast, and the interior

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1/ Figures indicate kilometers from La Voulte-Rhone.

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area between. In addition, it is of major importance as a by-pass route for traffic to southern France in general.

The gradient is very small. The maximum permissible axle load is 16 tons. There are numerous major bridges and tunnels. Since information on the details of construction of these engineering works is not available ~~xxx~~ the following target priority list is subject to revision.

1. Bridges

   Over R. Bleu -- 0 - 6[1/]

   Over R. Ceou -- 6 - 12

   Over R. Vert -- 18 - 26

   Over tributary of R. Ceou -- 18 - 26

   Over unidentified rivers -- 12 - 18 (2 bridges); 26 - 32 (2 bridges)

2. Tunnels

   Tunnel de Roques -- 18 - 26

   This tunnel is over 1 1/2 kms. long

   Marot tunnel -- 6 - 12

   This tunnel is 1.07 kms. long

   Unidentified tunnels -- 0 - 6; 12 - 18 (2 tunnels); 26 - 32; 32 - 41

1/ Figures indicate kilometers from Gourdon.

R+A 1268

French Route Nationale System

follows p 31

#21

R+A 1208

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#22